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Volume 5 Number 16 / August 23, 1967

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page

01 AERODYNAMICS
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. **2811**

02 AIRCRAFT
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03 AUXILIARY SYSTEMS
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **2820**

04 BIOSCIENCES
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology. **2824**

05 BIOTECHNOLOGY
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences. **2837**

06 CHEMISTRY
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. **2842**

07 COMMUNICATIONS
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. **2854**

08 COMPUTERS
Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. **2864**

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. **2866**

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **2871**

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. **2872**

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. **2875**

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. **2882**

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. **2891**

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. **2899**

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. **2901**

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see : 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. **2905**

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. **2914**

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. **2917**

20 METEOROLOGY
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. 2924

21 NAVIGATION
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. 2926

22 NUCLEAR ENGINEERING
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. 2928

23 PHYSICS, GENERAL
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. 2936

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. 2940

25 PHYSICS, PLASMA
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 2952

26 PHYSICS, SOLID-STATE
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. 2957

27 PROPELLANTS
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. 2961

28 PROPULSION SYSTEMS
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. 2961

29 SPACE RADIATION
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. 2965

30 SPACE SCIENCES
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. 2965

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. **2972**

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. **2977**

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. **2983**

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. **2988**

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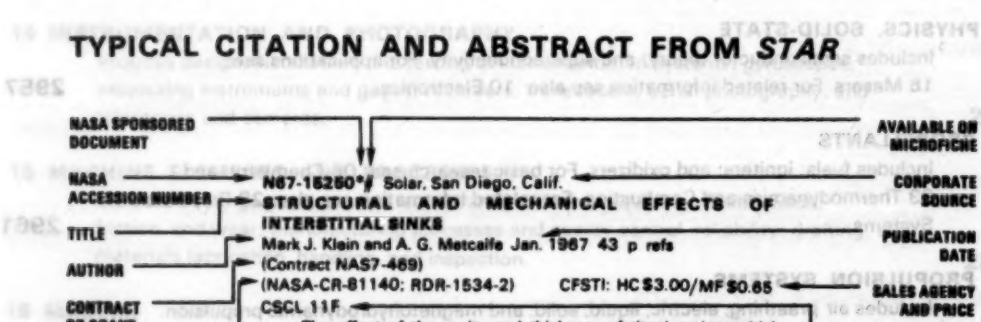
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STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
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Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
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The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

VOLUME 5, NUMBER 16 / AUGUST 23, 1967

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N67-28982# Mississippi State Univ., State College. Aerophysics Dept.

AN EXPERIMENTAL INVESTIGATION OF THE EFFECT OF FORWARD AND REARWARD MOTION ON THE THRUST OF A SHROUDED PROPELLER

Joe F. Thompson, Jr. Sep. 1966 95 p refs
(Contract DA-44-177-AMC-892(T))
(RR-65; USAAVLABS-TR-66-65; AD-649693) CFSTI: HC $3.00/MF $0.65

Experimental evidence of the existence of a stagnation line between the leading and trailing edges on the outer surface of the shroud of a shrouded propeller in the static condition, in rearward motion, and in forward motion is presented. This stagnation line on the outer surface, which is a result of viscous interaction between the propeller slipstream and the external flow, causes a reduction in shroud circulation below that calculated by distributed singularities methods which assume a stagnation line at the trailing edge only. Shroud thrust decreases as the distance between this stagnation line and the trailing edge increases. It is shown that in rearward motion, such as is the case for a VTOL aircraft landing, the stagnation line moves forward from the vicinity of the trailing edge to the vicinity of the leading edge as vehicle speed increases. This forward movement of the stagnation line results in a significant loss in thrust, which can be correlated with the stagnation line location. Shroud pressure distribution, stagnation line location, and shroud thrust are presented for all three cases of motion at several propeller pitch angles, propeller rotational speeds, and vehicle linear speeds. It is shown that the flow pattern about the shroud is rather complicated in rearward motion, involving two coaxial ring-vortices surrounding the shroud.
Author (TAB)

N67-28988# Pennsylvania State Univ., University Park. Ordnance Research Lab.

AN EXPERIMENTAL INVESTIGATION OF THE UNSTEADY WAKE BEHIND AN OSCILLATING WING IN TWO-DIMENSIONAL, INCOMPRESSIBLE NONCAVITATING FLOW

A. H. Magnuson 10 Feb. 1967 87 p refs
(Contract NOw-65-0123-d)
(TM-607 2441-10; AD-650475) CFSTI: HC $3.00/MF $0.65

A study of the wake produced by an oscillating wing in a two-dimensional noncavitating flow was conducted in a water tunnel using small air bubbles as flow tracers. High-speed motion pictures were taken of the air bubble motion in the wake and near the trailing edge of the wing while it was oscillating in a pitching motion about the quarter-chord. Films were taken for reduced frequencies from 0.5 to 1.7. Two mean angles of attack and two amplitudes of oscillation were studied. Velocity measurements in the wake were made for one film. The flow at the trailing edge was observed to be tangential for low mean angles of attack only. The vorticity rolling-up process in the wake differed from the nonlinear inviscid lifting body theory in two ways: the vorticity rolled up into two or three line vortices for each half-wavelength in the wake, and the vorticity convection in the wake was retarded.
Author (TAB)

N67-29037*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

HYPERSONIC VISCOUS DRAG ON CONES IN RAREFIED FLOW

Marvin I. Kussoy Washington, NASA, Jun. 1967 14 p refs
(NASA-TN-D-4036) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Drag was measured in the rarefied flow regime for cones of 1° to 30° semivertex angle to determine the effects of viscous flow. The tests were conducted in the Ames 1-foot shock tunnel in air at Mach numbers of 10 and 14 and Reynolds numbers, based on cone length, of from 600 to 32,000. A free-flight experimental technique was used which avoided possible model-support sting interference effects. Drag coefficients predicted by weak-interaction theory were larger than those measured, indicating the possible presence of a merged layer which cancels a portion of the interaction effects. The viscous parameter correlated the drag data taken at both Mach numbers for the 1°, 10°, 15°, and 30° cones. For cone angles of 2.5°, 5°, and 7.5°, the M=10 drag data fell below that observed for M=14, indicating that any merged layer effects on these particular bodies are possibly a function of Mach number as well as the viscous parameter. Published drag measurements for wide ranges of Mach numbers (2 to 21), viscous parameters (0.02 to 0.35), cone semivertex angles (5° to 15°), and wall temperature ratios (0.02 to 1.0) were correlated by plotting the ratio of viscous drag to viscous parameter against the wall temperature ratio.
Author

N67-29112# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.

CASCADE DATA FOR HIGH CAMBER BLUNT TRAILING EDGE BLADES

F. Breugelmans and C. Sieverding Nov. 1966 47 p *Its* Internal Note 17
(Grant AF-EOAR-65-65)
(ARL-67-0064; SR-1; AD-651183) CFSTI: HC $3.00/MF $0.65

A blunt trailing edge blade is tested at inlet Mach numbers varying from 0.60 to 1.00, over an incidence range of -3 to +7 degrees. Increase of the solidity from 2 to 3 increased turning and static pressure coefficient by 6 degrees and 7% respectively. The corresponding minimum loss coefficient decreased from 20% to 17%. Important compressibility effects are observed in this high cambered blade passage. This allows back pressure application. Systematic testing is performed for the incidences at Mach number 0.80 and 0.90. Author (TAB)

N67-29119# General Electric Co., Philadelphia, Pa.
HYPERSONIC DYNAMIC STABILITY. PART II: CONICAL BODY EXPERIMENTAL PROGRAM Final Report, May 1963–Oct. 1965
R. B. Hobbs, Jr. Jan. 1967 70 p refs
(Contract AF 33(657)-11411)
(FDL-TDR-64-149, Pt. II; AD-650866) CFSTI: HC $3.00/MF $0.65

Wind tunnel tests were conducted at M = 10 and at M = 14 and 20 to obtain experimental data on the hypersonic dynamic stability characteristics of a 10-degree half-angle cone. These data were generated to support dynamic stability studies and to evaluate the effects of many geometric and environmental variables, which influence the oscillatory motion of re-entry vehicles. The state-of-the-art of experimental ground testing in hypersonic dynamic stability is reviewed in detail with respect to simulation and data measuring capabilities. Data correlations were obtained to compare facilities and to evaluate the degree of consistency of results using different techniques in measuring and reducing the data. The confidence level for the data is established by means of these correlations, and conclusive interpretations of the data for application in flight estimates can only be made when the significance of these correlations are fully realized. The data correlations do bring out definite inconsistencies in test results and demonstrate the more obvious shortcomings of ground test simulation in this type of experiment research. Test results indicate that the 10-degree cone configuration is dynamically stable over the entire scope of matrix variables covered in the experimental program. Dynamic instabilities observed in flight remain unconfirmed by these ground test results. Author (TAB)

N67-29175*# Aerostructures, Inc., Palo Alto, Calif.
AERODYNAMIC CHARACTERISTICS OF TWO 20 PERCENT THICK, RECTANGULAR WINGS UP TO 90° ANGLE OF ATTACK AT SUBSONIC, TRANSONIC, AND SUPERSONIC SPEEDS
Greenfield A. Randall, Jr. 19 Apr. 1967 98 p refs
(Contract NAS2-3814)
(NASA-CR-73097) CSCL 01A

Tests were conducted in four wind tunnels to obtain aerodynamic coefficients for two wall mounted, 20 percent thick, rectangular wings, one of a double wedge and the other of a modified elliptic profile. Angles of attack up to 90° were covered at ten Mach numbers ranging from 0.20 to 3.50. Section data was obtained by attaching a large plate to the tip of each wing. Spanwise loading information was determined for each wing up to 214 percent chord from the free tip. Author

N67-29234# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
NOTE ON THE CONCEPT OF BLUNT TRAILING EDGE BLADES
Jacques Chauvin and Frans Breugelmans Jan. 1967 37 p refs *Its* Internal Note 21
(Grant AF-EOAR-65-65)
(SR-2; ARL-67-0063; AD-650606) CFSTI: HC $3.00/MF $0.65

The concept of blunt trailing edge blading for use in supersonic axial compressors is described, and its expected advantages and disadvantages are discussed. Its basic features - the possibility of decelerating a supersonic flow to subsonic velocities by means of a multiple shock system - are shown to be valid, as well as the possibility of having efficient deceleration by a sudden increase in flow passage area, if this change of area is kept within certain limits. Use of a constantly diverging section proves beneficial for operation in subsonic, transonic and supersonic flows. The advantage of using a twisted blading for the rotor is shown by the experimental results. Satisfactory cascade, rotor and stage performances were obtained with a wide range of bladings using the concept, from subsonic to supersonic speeds. Its potential could be used in both low and high hub to tip ratio supersonic compressor stages. Author (TAB)

N67-29359*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF TWO PROBE ANTENNAS ON AERODYNAMIC CHARACTERISTICS OF APOLLO SPACECRAFT AT MACH 10.03
Lawrence E. Putnam Washington, NASA, Jun. 1967 19 p refs
(NASA-TN-D-4034) CFSTI: HC $3.00/MF $0.65 CSCL 22B

An investigation has been made in the Langley 15-inch hypersonic flow apparatus at a Mach number of 10.03 to determine the effects of two interchangeable probe antennas on the aerodynamic characteristics of a model of the Apollo reentry vehicle. Tests were made at a Reynolds number, based on model maximum diameter, of 0.37×10^6 at angles of attack from about $-1.8°$ to $30.2°$ at a sideslip angle of $0°$. Angles of sideslip from $-4°$ and an angle of attack of approximately $18.7°$ were used. Results indicated that the only significant effect of adding either probe antenna to the basic configuration was a reduction in pitching-moment coefficient and a corresponding decrease in trim angle of attack. Trim angle of attack decreased by about $1.2°$ and $1.7°$ as a result of adding the standoff probe antenna and the close-in probe antenna, respectively, to the basic vehicle. Author

N67-29495# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
AN EXPERIMENTAL STUDY OF HYPERSONIC RAREFIED FLOW OVER A 10° CONE
Roy Scott Hickman Sep. 1966 28 p refs Presented at the 5th Intern. Symp. on Rarefied Gas Dyn., Oxford Univ., England, 4–8 Jul. 1966
(Grant AF-AFOSR-697-66)
(USCAE-101; AFOSR-66-2410; AD-643272) CFSTI: HC $3.00/MF $0.65

The local values of temperature, density, and impact pressure were measured for flow over a 10 degree total angle cone aligned with a Mach 9.4, 300°K stagnation temperature, low density flow of nitrogen. The density and temperature were measured using electron beam techniques. The flow was produced in a conical nozzle which produced a useful inviscid core of approximately 2 inches dia. The entire flow field exhibits strong interaction or rarefied phenomena. The flow field appears to approach continuum behavior as it proceeds downstream, however, near the cone tip the presence of the hot surface affects the external density gradient or 'shock'. Because of the presence of the body, the density ratio across the apparent shock does not satisfy the Rankine-Hugoniot conditions. The local impact pressure profiles normalized to free stream impact pressure are similar in shape to the local density data. The local temperature data indicates that the gradient is highest near the wall close to the tip and decreases with distance from the model tip. The resulting temperature jump at the wall is of order of magnitude of 200°K and decreasing with increasing distance from the tip. Author (TAB)

N67-29525# Advisory Group for Aerospace Research and Development, Paris (France).
A REVIEW OF SOME RECENT PROGRESS IN UNDERSTANDING CATASTROPHIC YAW
John D. Nicolaides (Notre Dame Univ.) 1966 22 p refs
(Contract AF 08(635)-5275)
(AGARD-551) CFSTI: HC $3.00/MF $0.65

Catastrophic yaw and roll lock-in are studied at supersonic and subsonic speeds. Roll lock-in is found to occur on isolated fins and is traced to a leading edge vortex. Free rolling motions are found to be accurately represented by the roll lock-in theory. Catastrophic yaw is observed in three-degree-of-freedom and six-degree-of-freedom wind tunnel tests. Mass asymmetry in a 10° cone is found to cause rolling velocity, roll lock-in, and catastrophic yaw. Author

N67-29543# Ballistic Research Labs., Aberdeen Proving Ground, Md.
ATTENUATION OF PEAKED AIR SHOCK WAVES IN SMOOTH TUNNELS
George A. Coulter Nov. 1966 84 p refs
(BRL-MR-1809; AD-650741) CFSTI: HC $3.00/MF $0.65

The attenuation of shock-front pressure for peaked air shock waves was measured along straight smooth-wall test sections of 1-, 2-, and 4-inch inside diameter shock tubes over travel distances up to 520-tunnel diameters. Shock overpressure between 50 and 450 psi for an ambient pressure of 1 atmosphere were produced by the use of helium or by burning M-9 propellant in the driver section of shock tubes. The lengths of the shock tube driver sections were changed to vary the shape of the shock waveform which caused the shock-front pressure to attenuate differently with distance. Pressure-time records are shown from piezoelectric pressure gages placed at ten test positions along the shock tube. Author (TAB)

N67-29584# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT EXPERIENCE WITH THE OGEE WING AT LOW SPEED
Fred J. Drinkwater, III (NASA. Ames Res. Center) and L. Stewart Rolls May 1966 24 p refs Presented to Flight Mech. Panel of the Advisory Group for Aerospace Res. and Develop., Paris, 10–13 May 1966
(AGARD-538) CFSTI: HC $3.00/MF $0.65

A basic delta-wing aircraft was modified on an Ogee planform and tested in flight following full-scale wind tunnel tests. The modified wing had a sharp leading edge compared to the original large radius, slatted leading edge. The modification produced strong leading-edge vortices which were easily observed and photographed as condensation trails. The stability of the vortices was examined in flight to 25° angle of attack and 8° sideslip and no detachment of the vortices or other discontinuous characteristics were indicated. A significant improvement in lateral–directional stability over that of the basic airplane was obtained at high angles of attack, which allowed a reduction in the minimum instrument approach speed. The improved lateral–directional characteristics made it possible to extend to lower speeds the study of other piloting factors which might determine the minimum approach speed. The effects of a range of static margins from −0.02 to +0.02 were examined. Also, the effect of a change in the slope of the power-required curve was investigated. Poor static longitudinal stability and reduced flight-path-angle control became the limiting factors. Author

N67-29602# General Electric Co., Philadelphia, Pa.
THE UNSTEADY FLOW FIELD ABOUT A RIGHT CIRCULAR CONE IN UNSTEADY FLIGHT
E. A. Brong Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jan. 1967 94 p refs
(Contract AF 33(657)-11411)
(FDL-TDR-64-148; AD-650869) CFSTI: HC $3.00/MF $0.65

The inviscid flow field about a right circular cone in unsteady planar flight is analyzed by a perturbation technique which is an extension of Stones treatment of the cone at small yaw. A solution is found in the form of infinite series in the time rates of change of the pitch rate and angle of attack. The linear stability derivatives as well as higher order stability derivatives are presented for a wide range of cone angles and Mach numbers. The stability derivatives as obtained from this solution are compared to results obtained from second order potential theory, Newtonian impact theory, and an unsteady flow theory due to Zartarian, Hsu, and Ashley. Both the potential theory and the impact theory predict that the stability derivative (angle of attack) approaches a value which is on the order of 10 percent to 20 percent of the stability derivative (pitch rate). Numerical results obtained from the present theory are also compared to ground-test data. The agreement is found to be generally good, although the data in some instances indicate a pronounced Reynolds number effect. Author (TAB)

N67-29607# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SUPERSONIC GAS FLOW PAST A CYLINDRICAL PROTUBERANCE ON A PLATE
D. M. Voitenko, A. I. Zubkov, and Yu. A. Panov 31 Jan. 1967 13 p refs
(Contract NOw-62-0604-c)
(TG-230-TB15; AD-650960) CFSTI: HC $3.00/MF $0.65

Wind-tunnel investigation was made of the flow past a cylindrical protuberance on a plate at a Mach number of 2.5. The shape of the separation line and the pressure distribution and flow orientation at the surface of the plate, obtained for cylinders of various diameter and height, are presented in graphical form. Author (TAB)

N67-29636# Ohio State Univ. Research Foundation, Columbus.
THE EFFECT OF TRANSVERSE ION CURRENT ON THE FLOW OF AIR IN A FLAT DUCT
Edwin R. Pajack and Henry R. Velkoff Feb. 1967 84 p refs
(Contract DA-31-124-ARO(D)-246)
(TR-2; AD-650639) CFSTI: HC $3.00/MF $0.65

Friction factors, velocity distributions, pressure gradients, and density measurements were made on a 5/8-inch x 5-inch rectangular flow channel with air flow. A plane of corona wires along the midplane of the channel was the source of ions which drifted across the air flow to the electrically grounded walls of the channel. Experimental data were collected to determine the influence of the ion flow on the air flow and the extent of the ion-fluid coupling. The electrodynamic and hydrodynamic equations were set up and several approximate solutions were obtained based on the postulation of a flow induced body force and the assumption of fully established, one-dimensional flow. The magnitude of the ion effects was found to be significantly dependent on the ion density distribution within the flow channel. Author (TAB)

N67-29778 Saab Aircraft Co., Linkoping (Sweden).
BASIC LOW SPEED AERODYNAMICS OF THE SHORT-COUPLED CANARD CONFIGURATION OF SMA 1 ASPECT RATIO
Hermann Behrbohm Jul. 1965 51 p refs
(Saab-TN-60) CFSTI: $3.00

Based on systematic windtunnel investigations with schematic models, an explanation is given of the basic structure of low speed flow past short-coupled canard configurations composed of two triangular wings of small aspect ratio. Interference effects between the two wings are shown to exist which for suitably positioned wings and for suitably chosen relative wing areas are

favorable for the vortex flows springing from the leading edges of both the canard wing and the main wing. Measures are described for increasing the lifting ability of the configuration by removing the inefficient vortex region of the main wing to the aerodynamically most efficient wing tip region. Longitudinal stability characteristics and trimmed lifting forces are studied and a comparison is made between the different possibilities of using the canard wing as a high-lift device only or as a trim device with superposed steering function. The influence of a jet-blown trailing edge flap of the canard wing is discussed both with regard to the maximum load to be supported by the canard wing and with regard to longitudinal stability and trimmed lifting force of the configuration. Finally, windtunnel measurements on several different models are discussed in order to illustrate stability about the axis of roll and about the axis of yaw at high angles of attack and high angles of sideslip. The short-coupled canard configuration is well suited to combine the necessary slenderness of a high-speed aeroplane with the high lift capability required by STOL aircraft in trimmed landing approach. Author

N67-29882# Aeronautical Research Council (Gt. Brit.)
EXPERIMENTS ON TWO-DIMENSIONAL BASE FLOW AT SUBSONIC AND TRANSONIC SPEEDS
J. F. Nash, V. G. Quincey, and J. Callinan London, HMSO, 1966 62 p refs Supersedes NPL-AERO-1070; ARC-25070; see N64-24855
(ARC-R&M-3427; NPL-AERO-1070; ARC-25070) CFSTI: HC $3.00/MF $0.65

A series of experiments were conducted to investigate the fundamental mechanisms of the flow behind an isolated blunt trailing edge section and a rearward facing step at subsonic and transonic speeds. Pressure measurements and flow photography were used along with an extensive wake exploration and a study of the vortex shedding process in connection with tests on the isolated section. Tests were also made of simple devices which interfere with the formation of the vortex street. The events associated with the transition, at transonic speeds, from the subsonic vortex street regime to the supersonic steady flow regime are considered. Tests on the step were aimed chiefly at providing information on the nonperiodic base flow which would exist behind a blunt trailing-edge aerofoil section at subsonic and transonic speeds if the formation of the vortex street could be inhibited. Author

N67-29887# Aeronautical Research Council (Gt. Brit.)
GUN TUNNEL MEASUREMENTS OF LIFT, DRAG, AND PITCHING MOMENT ON A 20° CONE, A FLAT DELTA AND A CARET DELTA WING AT A MACH NUMBER OF 8.3
T. Opatowski (Imperial Coll. of Sci. and Technol.) London, HMSO, 1966 48 p refs Supersedes ARC-27582; see X66-21349
(ARC-CP-908; ARC-27582) CFSTI: HC $3.00/MF $0.65

Measurements of life, drag and pitching moment have been made on a 20° half-angle, right-circular cone and on two delta wings of triangular and caret cross section, 10° wedge angle and aspect ratio 1 in the gun tunnel. The strain gauge balance developed for this purpose gave results which were within 5% of other published cone data. Maximum lift/drag ratios of about 3·7 were obtained for both wings at the test Mach number of 8·3 and Reynolds number based on root chord of $1{\cdot}5\times10^6$. The measured lift, drag and lift/drag ratio agreed well with estimates based on two-dimensional oblique shock theory and laminar skin friction. Author

N67-29893# Aeronautical Research Council (Gt. Brit.)
CAMBER EFFECTS ON THE NON-LINEAR LIFT OF SLENDER WINGS WITH SHARP LEADING EDGES
L. C. Squire (Cambridge Univ.) London, HMSO, 1967 38 p refs Supersedes ARC-27651; see X66-21640
(ARC-CP-924; ARC-27651) CFSTI: HC $3.00/MF $0.65

A study of published work on slender wings has shown that the nonlinear lift is often increased by leading edge droop. In this note the results are given of an investigation, made on simple, conically cambered wings, to study this effect in more detail. It is found that the main parameter which determines the increase in nonlinear lift is the angle of droop at the leading edge. The magnitude of the increase, and the corresponding movements of the vortex positions, are predicted qualitatively by a simple extension to the Brown–Michael theory carried out for conically cambered wings with circular arc cross sections. A study of the theoretical results shows that the principal cause of the increase in lift is the distortion of the velocity field of the vorticity which is produced by the curvature of the wing in the cross-flow plane. Author

N67-29894 Aeronautical Research Council (Gt. Brit.)
TESTS ON AN ENGINE INSTALLATION FOR A SLENDER GOTHIC WING AT M = 1.82
R. T. Griffiths London, HMSO, 1967 55 p refs Supersedes RAE-TN-AERO-2982; ARC-26912; see X65-18314
(ARC-CP-866; RAE-TN-AERO-2982; ARC-26912) HMSO: 11s

Tests were made at M = 1.82 over an incidence range of ±10° on an engine installation mounted at the rear of an uncambered slender gothic wing with different values of the boundary layer bleed height and at various mass flow ratios. In addition, an investigation was made of the flow conditions at the inboard and outboard edges of the inlet and of the effects of the nacelles on the longitudinal characteristics of the wing. It was found aerodynamically preferable to mount the engines on the lower rather than the upper surface of the wing in order to avoid the possibility of the leading edge vortices entering the intake and to take advantage of the reduced local Mach number present under lifting conditions. With a reasonable boundary layer bleed height, addition of the nacelles to the wing caused a 15% increase in drag, almost independent of incidence. About 30% of this increase was the drag of the boundary layer bleed duct; the remainder could be calculated closely from a knowledge of the nacelle geometry. The nacelles caused small displacements of the lift and pitching moment curves. Author

N67-29896# Aeronautical Research Council (Gt. Brit.)
BOUNDARY LAYER CHARACTERISTICS OF CARET WINGS
D. Catherall London, HMSO, 1963 30 p refs Supersedes RAE-TN-AERO-2835; ARC-24222; see N64-10055
(ARC-CP-694; RAE-TN-AERO-2835; ARC-24222) CFSTI: HC $3.00/MF $0.65

The theory of laminar boundary layers along flat surfaces has been used in conjunction with Eckert's intermediate enthalpy method to obtain approximations to the displacement thickness, skin friction, and temperature profiles on the undersurface of a caret wing configuration. To a first approximation it has been assumed that parallel flow exists behind the shock outside the boundary layer, and the displacement of the shock by the boundary layer near the leading edge is neglected. Conduction of heat within the body and along the surface is neglected, but radiation is included, so that local values of equilibrium temperature are found. Examples are given for various altitudes and configurations and the effect of the skin friction on the lift/drag ratio is calculated, assuming the undersurfaces to be plane. Author

N67-29898# Aeronautical Research Council (Gt. Brit.)
THE SEPARATED FLOWS ON SLENDER WINGS IN UNSTEADY MOTION
M. V. Lowson London, HMSO, 1967 44 p refs Supersedes ARC-25118; see X65-12962
(ARC-R&M-3448; ARC-25118) CFSTI: HC $3.00/MF $0.65

The separated flows on slender wings in unsteady motion were analysed using an extension of the steady-state theory of Brown and Michael. The results were computed for the cases of

heaving and pitching oscillations of a slender delta wing. An unexpected phenomenon was that the vortex cores moved rapidly inboard as the wing reached zero local effective incidence. These theoretical results were essentially confirmed by an experimental investigation in a water tunnel. Author

N67-29900 Royal Aircraft Establishment, Farnborough (England).
GUIDED WEAPONS AERODYNAMIC STUDY CHARACTERISTICS OF AFT MOUNTED ALL-MOVING RECTANGULAR CONTROL SURFACES ON A SLENDER CRUCIFORM MISSILE AT MACH NUMBERS FROM 0.6 TO 2.8
K. G. Winter and Susan M. Mills Oct. 1966 212 p refs
(RAE-TR-66326; AD-805162)

The wings of delta planform, with aspect ratio of exposed pairs of panels 0.31, and total span of 2.5 times the diameter of the body, which is of fineness ratio 19. The rectangular controls, of span equal to that of the wings, and chord 0.5 times the body diameter, are mounted with a half chord gap to the wing trailing edge. Loads are measured on one control in addition to over-all loads. The tests cover an incidence range up to 22 degrees for 0 and 45 degrees roll and a complete roll range for incidences of 6, 12 and 20 degrees with elevator angles of 0, 10, 20 and 30 degrees. A brief survey of the flow in the region of the tail at M = 2.8 at an incidence of 20 degrees is included. The results show that there are large variations with roll angle in both stabiliser effectiveness in pitch and elevator effectiveness. Aileron effectiveness is fairly constant. The rolling moment variation with roll angle on the complete model changes from being stable when one pair of wings is horizontal for all incidences at subsonic speeds and for low incidence at supersonic speeds, to being unstable for high incidence at supersonic speed. It is suggested that this effect may arise mainly from the interaction of the body vortices and of the vortices from the near horizontal wings with the wing on the leeside of the body. Author (TAB)

N67-29909# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL EXPERIMENTS ON A LIFTING JET IN A BLUFF BODY WITH AND WITHOUT WINGS
W. J. G. Trebble London, HMSO, 1966 41 p refs Supersedes RAE-TN-AERO-2971; ARC-26390
(ARC-CP-859; RAE-TN-AERO-2971; ARC-26390; AD-805498) HMSO: 7s 6d

Measurements have been made of the interference loads arising from the interaction between a mainstream and a relatively large jet efflux emerging from the lower surface of a bluff body. As the ratio of mainstream velocity to jet efflux velocity is increased from zero, the lift increment due to the jet is initially reduced and a nose-up moment is produced. The maximum loss is about a quarter of the installed thrust but at higher values of the velocity ratio some lift recovery occurs. Similar trends are observed with a wing fitted but the lift recovery at high velocity ratios and the associated nose-up moments are greater due to additional circulation lift carried on the wing. An attempt has been made to deduce the interference loads due to an intake from the difference between these results and those for a geometrically similar lifting-fan model. This analysis suggests that the intake flow gives rise to large lift and nose-up moment increments which are augmented by the presence of a wing. Author (TAB)

N67-29917 Aeronautical Research Council (Gt. Brit.)
SUPERSONIC FLUTTER DERIVATIVES FOR A SERIES OF SWEPT AND CROPPED DELTA WINGS
G. Z. Harris London, HMSO, 1967 31 p refs Supersedes
(ARC-CP-920; RAE-TR-66003; ARC-28117) RAE-TR-66003; ARC-28117 HMSO: 6s

A program for the experimental and theoretical determination of flutter derivatives for a series of swept and cropped delta wings was initiated. This report gives values of the pitching and heaving derivatives for a number of these planforms in the intermediate supersonic speed range. The derivatives have been found using supersonic lifting surface theory. Author

N67-29932 Aeronautical Research Council (Gt. Brit.)
STUDIES OF THE FLOW FIELDS CREATED BY SINGLE VERTICAL JETS DIRECTED DOWNWARDS UPON A HORIZONTAL SURFACE
M. Cox and W. A. Abbott Oct. 1964 39 p refs
(ARC-CP-912) HMSO: 7s 6d

The velocity and temperature conditions in the space surrounding a single nozzle discharging hot gas vertically downwards on to a horizontal surface were studied. Except at very low exit velocities, the amount of recirculation to an intake situated on the axis of the jet is small. Within limits, the dynamic head at ground level at a point away from the axis is independent of the height of the nozzle above the ground. These limits are decided by the spread of the jet before it reaches the ground, and by the lateral extent of the jet before it separates and rises from the ground. A parameter including the initial velocity of the jet and its temperature is used to define both the vertical penetration of the jet and its lateral extent if it strikes the ground. The rate of decay of dynamic head in the jet along its axis and across the ground was studied. In transient experiments, the rate of progress of the initial spread of the jet across the ground was determined. Author

N67-29942# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
AERODYNAMIC DAMPING BLADE VIBRATIONS IN TURBO-MACHINES [AMORTISSEMENT AERODYNAMIQUE DES VIBRATIONS DES AUBES DE TURBO-MACHINES]
Robert Lagendre [1967] 59 p refs In FRENCH; ENGLISH summary
(ONERA-TN-107(1967)) CFSTI: HC $3.00/MF $0.65

The problem of predicting the forces due to blade vibrations in turbo-machines is discussed in its generality and minimum assumptions for simplification are introduced so that the problem can be solved. Appreciable progress is assured by the systematic exploitation of Poincare's uniformisation process permitting to study the flow around practically any blade and to inverse the integral equations which were up till now written and labouriously solved in some very particular cases without giving a good precision. The solution presented is effective in very general cases. Author

N67-29950 National Lucht-en Ruimtevaartlaboratorium, Amsterdam (Netherlands).
WAVE PROPAGATION IN TRANSONIC FLOW PAST TWO-DIMENSIONAL AEROFOILS
B. M. Spee 27 Jul. 1966 13 p refs
(NLR-TN-T.123)

In this note the results of a preliminary theoretical investigation on the behaviour of disturbance waves in smooth, transonic, two-dimensional flows are discussed. It is pointed out that a connection may exist between the behaviour of such waves and the generation of a shock wave. The considerations show that possibly a criterion for the stability of smooth transonic flows past aerofoils can be found in this way. The result appears to correspond to Pearcey's experience as it points to profiles with a peaky pressure distribution to be favourable. Author

N67-29973# Aeronautical Research Council (Gt. Brit.)
WIND TUNNEL STUDIES OF LEADING EDGE SEPARATION PHENOMENA ON A QUARTER SCALE MODEL OF THE OUTER PANEL OF THE HANDLEY PAGE "VICTOR" WING, WITH AND WITHOUT NOSE DROOP
R. A. Wallis (Dept. of Supply, Australia) London, HMSO, 1967 68 p refs Supersedes ARC-19227; ARC-20037; ARC-21019
(ARC-R&M-3455; ARC-19227; ARC-20037; ARC-21019)

Leading edge flows, present in the incidence range embracing the onset of general nose separation, were studied experimentally. The effect of nose droop of these flows was established during the development of this device as a possible alternative to leading-edge flaps on the aircraft. Discrete air jets and vane type vortex generators were investigated in regard to both boundary layer and hysteresis control. The influence of trailing-edge flaps on leading-edge separation phenomena was also studied. The concepts outlined in regard to the nature of nose stalling problems and the quantitative data presented should have application in respect to general wing design. Author

N67-30047# Aeronautical Research Council (Gt. Brit.)
THE PRESSURE DRAG OF AN AEROFOIL WITH SIX DIFFERENT ROUND LEADING EDGES, AT TRANSONIC AND LOW SUPERSONIC SPEEDS
P. G. Wilby Jan. 1966 24 p refs
(ARC-CP-921)

The experimental pressure drags of a two-dimensional aerofoil are compared for a wide range of leading-edge radii and other variations in curvature distribution at transonic and low supersonic speeds. It is found that the drag does not increase with increasing leading-edge radius if the profile is designed so as to generate a rapid supersonic expansion. Furthermore, for a given radius, significant reductions in drag can be achieved by changing the way in which the leading-edge circle blends into the overall profile. Author

N67-30064 Lockheed Missiles and Space Co., Sunnyvale, Calif.
INVESTIGATION OF THE INFLUENCE OF NONLINEAR FACTORS ON THE VIBRATIONS OF A ROD IN A GAS FLOW
N. S. Lobikov [1967] 8 p refs Transl. into ENGLISH from Izv. VUZ. Aviats Tekh. (Kazan), no. 1, 1967 p 10–16

The question of the qualitative influence of the nonlinearity in elastic and aerodynamic characteristics, as well as of aerodynamic hysteresis, on vibrations of a rod is considered. The solution of this problem is accomplished on the basis of replacing an actual rod by a chain of rigid links with elastic hinges. The construction of the appropriate system of equations and recommendations for the solution are given. The extreme complexity of the equations eliminates the possibility of investigating them in general form. An analysis of the combined influence of the noted factors by computational means is associated with a great expenditure of machine time, even if modern electronic computers are utilized for this purpose. Taking this into account, vibrations of the simplest model represented by a stiff rod of constant cross section which is fixed by means of an elastic hinge are considered. Author

N67-30092# National Aerospace Lab., Tokyo (Japan).
SEMI-EMPIRICAL THEORY TO ESTIMATE THE AIRFORCES ACTING ON THE HARMONICALLY OSCILLATING TWO-DIMENSIONAL WING AT HIGH ANGLE OF ATTACK WHERE SEPARATION CAN OCCUR
Kozi Isogai Dec. 1966 17 p refs In JAPANESE; ENGLISH summary
(NAL-TR-122; UDC-533-691) CFSTI: HC $3.00/MF $0.65

The prediction of the airforces acting on the airfoil oscillating at high angles of attack where the flow separation can occur is of great importance for stall flutter analysis. This paper presents a semi-empirical theory for estimating the unsteady lift forces and moments of the airfoils oscillating in bending and in torsion respectively, by using the experimentally obtained static lift and moment curves incorporated with the aerodynamic hysteresis effect of the separated flow. The aerodynamic damping coefficients are obtained as the functions of mean angle of attack, amplitude and reduced frequency. It is shown that the aerodynamic damping is considerably increased due to the aerodynamic hysteresis effect of the separated flow in case of bending oscillation. This is in contrast with the well known fact that the aerodynamic hysteresis effect decreases the aerodynamic damping in torsional oscillation. The calculated moment loops are compared with the experimental loops. Author

N67-30127*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
REVIEW OF PROPELLER-ROTOR WHIRL FLUTTER
Wilmer H. Reed, III Washington, NASA, Jun. 1967 29 p refs
(NASA-TR-R-264) CFSTI: HC $3.00/MF $0.65 CSCL 01C

A survey is made of the state of the art of propeller-whirl flutter—a precession type instability that can occur on a flexibly mounted aircraft engine-propeller combination. Literature relating to this problem from the time it first became of concern on conventional turbopump and V/STOL aircraft is reviewed. Included in the survey are a description of the basic mechanism of whirl flutter, a summary of generalized trend studies on idealized systems, the status of methods for predicting propeller aerodynamic coefficients, the effects of flapping hinged blades and twisted flexible blades on whirl flutter, and some approaches for including propeller whirl modes as a part of the flutter evaluation for complete aircraft. Also, brief consideration is given to the response of flexibly mounted propeller-nacelle systems to random atmospheric turbulence. Whirl flutter of conventional propeller-nacelle systems is now a reasonably well understood phenomenon and amenable to analysis. For propeller-rotor systems with flapping blades, however, comparisons between experiment and theory suggest the need for further refinements in the mathematical model. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-28988 Air Weather Service, Washington, D. C.
CLIMATOLOGICAL PROBABILITY OF AIRCRAFT ICING
Lawrence G. Katz Jan. 1967 29 p refs
(TR-194; AD-649619) CFSTI: HC $3.00/MF $0.65

The report presents seasonal Northern Hemisphere isopleth charts depicting the climatological probability of aircraft icing at 5,000, 10,000, 15,000, and 20,000 feet. It also describes the method used in determining these probabilities. A discussion of the data employed is also given. Author (TAB)

N67-29033*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DETERMINATION OF FLIGHT CHARACTERISTICS OF SUPERSONIC TRANSPORTS DURING THE LANDING APPROACH WITH A LARGE JET TRANSPORT IN-FLIGHT SIMULATOR
Washington, NASA, Jun. 1967 185 p refs
(NASA-TN-D-3971) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An in-flight simulation has been made to determine the handling qualities of several supersonic transport configurations during the landing approach. This part of the compilation describes the test program, the SST test configuration, the simulator, and the stability augmentation for the SST test configurations. The discussion of the simulator covers several topics including the test airplane, the simulation technique, the simulation equations, the simulator specifications, the simulation procedures, and examples of the quality of simulation. Author

N67-29049# David Taylor Model Basin, Washington, D. C.
SUMMARY REPORT OF WIND-TUNNEL INVESTIGATIONS OF A 1/20-SCALE POWERED MODEL OPEN-OCEAN V/STOL SEAPLANE
Richard O. Thomas Jan. 1967 49 p refs
(DTMB-2181; DTMB-AERO-1108; AD-651009) CFSTI: HC $3.00/MF $0.65

Low-speed wind-tunnel tests were conducted on a 1/20-scale powered model of a proposed open-ocean V/STOL seaplane design. Hover and transition power required and climb and descent speeds at various flight path angles were determined. The effect of full-span spoilers on wing and canard stalling characteristics through transition was briefly investigated. A comparison of cruise performance of the seaplane and a conventional transport of equivalent size was made. After correction of the seaplane model cruise lift curve and drag polar to full-scale Reynolds number, cruise performance of the seaplane was found to compare favorably with that of the conventional monoplane. In the transition mode, the model is longitudinally unstable at high wing tilts and directionally stable at all wing tilts for the initial center-of-gravity location. With the present relationship of wing, canard, and center of gravity, the model cannot be trimmed in pitch by varying only incidence of the canard with uniform thrust setting on all engines. Differential thrust, the mechanism envisioned for hover control, is necessary for pitch trim and control throughout most of the transition mode.
Author (TAB)

N67-29058# Honeywell, Inc., Minneapolis, Minn.
FLUID STATE HYDRAULIC DAMPER Final Report, 1 Jul. 1965–24 Jun. 1966
Robert V. Burton, Donald N. Carlson, Richard L. Heinecke, and Robert R. St. John Feb. 1967 157 p
(Contract DA-44-177-AMC-294(T))
(Rept.-15-003R; USAAVLABS-TR-66-87; AD-651104) CFSTI: HC $3.00/MF $0.65

The report covers the developmental work accomplished on a program to demonstrate the feasibility of using fluidic sensing amplification and signal shaping techniques to mechanize a single-axis, rate feedback damper system for V/STOL aircraft. The specific design goal was to increase the yaw axis damping ratio of the UH-1B helicopter from 0.30 unaugmented to 0.60 augmented. The control problem was analyzed and the damper system mechanization defined through the use of analog and digital computer simulation techniques. The component hardware was designed, fabricated, and bench tested. Closed-loop system bench testing, using an analog computer to simulate the UH-1B helicopter, showed that the fluidic damper system was feasible for helicopter control system mechanization. The addition of the damper system to the simulated aircraft raised the yaw axis damping ratio from 0.30 unaugmented to 0.60 augmented. Author (TAB)

N67-29182# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMICS OF AIRFRAME-ENGINE INTEGRATION OF ADVANCED SUPERSONIC AIRCRAFT
Mark R. Nichols *In* AGARD Gas Turbines 1966 p 1–44 refs (See N67-29181 16-28)

The purpose of this paper is to review from the airframe viewpoint some major aerodynamic problems involved in the design of the propulsion-system installations of advanced supersonic aircraft. Consideration is given to environmental factors such as flow fields, the airframe boundary layer, airframe-inlet and inlet-inlet shock interference, and jet-airframe interference. New aerodynamic tools available to the designer are discussed and are used along with experimental data to analyze the overall drag minimization problem of multiengine aircraft including consideration of the effects of location, size, shape, and orientation of the nacelles. Finally, detailed attention is given to the problem of optimizing the propulsion system itself from the standpoint of inlet and nozzle selection, flow distortion effects, handling of the various secondary airflows, and afterbody drag. Author

N67-29183# Royal Aircraft Establishment, Bedford (England).
FACTORS DETERMINING ENGINE INSTALLATION DRAG ON SUBSONIC AND SUPERSONIC LONG-RANGE AIRCRAFT
J. Seddon *In* AGARD Gas Turbines 1966 p 45–64 refs (See N67-29181 16-28)

The paper discusses three speed categories which are significant in relation to the future development of the gas turbine engine and its high speed derivative, the ramjet. For high subsonic speeds, podded engines are in vogue and seem likely to remain so as the trend in bypass engines (fanjets) develops. With pod installations the interference drag between pods, support struts, and the neighboring airframe surfaces can be quite high. Previously documented information on wing installations is recalled and some recent results from experiments on rear fuselage installations are shown. At moderate supersonic speeds the wave drag, which for a single isolated engine nacelle is high, can be reduced by employing either the principles of favorable interference or those of shape integration. Another problem in this speed range is the drag of boundary layer bleed systems. Above Mach 3 the most significant advance would come from effective integration of a fully-expanded propelling nozzle into the airframe layout. Successful engine-airframe integration could actually improve the lift/drag ratio as compared with that for the basic airframe without propulsion system. Author

N67-29184# Technische Univ., Berlin (West Germany).
FULL INTEGRATION OF VTOL POWER PLANTS IN THE AIRCRAFT FUSELAGE
Heinrich Hertel *In* AGARD Gas Turbines 1966 p 65–96 (See N67-29181 16-28)

The lifting fans of VTOL aircraft need to be integrated into the airframe to avoid the additional drag caused by them. The exhaust jets from the lifting fans should be placed near the aircraft's center of gravity so that in the event of engine trouble, there would be no serious pitching or rolling moments to control. Drag in supersonic aircraft can be eliminated by using fuselage shapes to cover the lifting fans. Several of these body shapes are shown and discussed. The lifting fans are retractable and are entirely inside the fuselage during cruising speeds. The fans swing out during takeoff and landing, thereby avoiding the problem of supplying a large volume of air to the fans. A solution to the problem of avoiding moments due to engine trouble is discussed by demonstrating a concept of a centered exhaust port for the lifting fans. It is shown that the problem of recirculating hot gases must be considered in the placement of the lifting fans. Experimental results and suggested solutions concerning this problem are discussed. Author

N67-29223# Aviation Safety Engineering and Research, Phoenix, Ariz.
ANALYSIS OF ARMY FIXED-WING CARGO RESTRAINT DESIGN CRITERIA Final Report
James P. Avery and Stuart Larsen Jan. 1967 80 p
(Contract DA-44-177-AMC-430(T))
(AvSER-66-21; USAAVLABS-TR-67-3; AD-651219) CFSTI: HC $3.00/MF $0.65

The report presents the findings of an investigation into the crash pulse of fixed-wing cargo aircraft and the resulting behavior of cargo restrained by load limiters. A crash pulse simulator computer program was developed that obtains acceleration-time histories at selected stations in the cargo compartment and under various crash conditions. This simulator was employed to obtain crash pulses for a wide range of input parameters, both for the

CV-2 and the CV-7 Army aircraft. The resulting acceleration pulses were studied to determine a suitable spectrum of realistic pulses. The crash pulse program was subsequently modified to include a routine that would simulate cargo dynamic behavior during the crash sequence, employing the floor acceleration data as it is developed. This latter program was applied to CV-2 and CV-7 aircraft, under significant crash conditions, to obtain the dynamic response of cargo to the crash pulse. Author (TAB)

N67-29356*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

LOW SUBSONIC FLIGHT AND FORCE INVESTIGATION OF A SUPERSONIC TRANSPORT MODEL WITH A HIGHLY SWEPT ARROW WING

Delma C. Freeman, Jr. Washington, NASA, Jun. 1967 51 p refs Film Supplement Number L-949 to this report is Available on Request from Langley Res. Center

(NASA-TN-D-3887) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation has been conducted in the Langley full-scale tunnel to determine the low-speed static and dynamic longitudinal and lateral stability characteristics of a model of a highly swept, blended-wing-body, supersonic commercial air transport configuration. Static force tests showed that the basic configuration had severe longitudinal instability in the form of a pitch-up at an angle of attack of about 10°, but instability could be shifted to an angle of attack of 25° by the use of several geometric modifications. With canard surface off, the model had satisfactory longitudinal flight characteristics at the low angles of attack but the longitudinal stability decreased with increasing angle of attack. The addition of a high-lift canard surface as part of a high lift system permitted an increase in lift coefficient of 0.1 in the angle-of-attack range for take-off and landing. This canard surface had no effect on the dynamic longitudinal stability except that it required about a 0.03 mean aerodynamic chord forward shift in the center of gravity to achieve the same longitudinal stability as the canard-off configuration. The addition of the canard surface also decreased the Dutch roll damping; and, at an angle of attack of about 20° with the canard surface on, the oscillation was unstable. Author

N67-29358*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

NASA RESEARCH ON NOISE-ABATEMENT APPROACH PROFILES FOR MULTIENGINE JET TRANSPORT AIRCRAFT

John A. Zalovcik and William T. Schaefer, Jr. Washington, NASA, Jun. 1967 43 p refs

(NASA-TN-D-4044) CFSTI: HC $3.00/MF $0.65 CSCL 01B

Approach-profile geometry, airplane type, navigational aids, and pilot augmentation were investigated in a NASA program concerned with the reduction of aircraft noise by studying operating problems associated with a steepened approach path for multiengine jet transports. Testing indicates an approach profile of about 6° to be feasible, and that pilot activity for glide-path control can make a spread in noise level of 8 dB for a nominal 6° approach. Prime source of noise reduction is in the power cutback to fly the steepened glide path which, in combination with the effect of increased height, amounts to about 13 dB in sound pressure level. Improved flight path control is required for steep approaches to low minimums of ceiling and visibility and for achieving reduced scatter about the lower noise level. M.W.R.

N67-29526# Advisory Group for Aerospace Research and Development, Paris (France).

VARIABLE STABILITY AIRCRAFT [AVION A STABILITE VARIABLE]

G. Klopfstein May 1966 30 p Presented at the 28th Meeting of Flight Group Mechanics, Paris, 10–11 May 1966

(AGARD-537) CFSTI: HC $3.00/MF $0.65

A description is presented of the first French variable stability aircraft; and piloting modes, safety devices, and simulation usage are discussed. The Mirage III-B 225 aircraft can be piloted both electrically and mechanically from the front and from the rear, and various aspects of flight management are considered.

Transl. by M.W.R.

N67-29536# Advisory Group for Aerospace Research and Development, Paris (France).

CORRELATION OF WIND-TUNNEL AND FLIGHT-TEST AERODYNAMIC DATA FOR FIVE V/STOL AIRCRAFT

David H. Hickey and Woodrow L. Cook (NASA, Ames Res. Center) Oct. 1965 30 p refs Presented at 27th Meeting of AGARD Flight Mech. Panel, Rome, 11–12 Oct. 1965

(AGARD-520) CFSTI: HC $3.00/MF $0.65

The five aircraft tested represent a wide variety of V/STOL concepts. Correlation between the wind-tunnel and flight-test aerodynamic results is generally good when wind-tunnel wall corrections are omitted; in some cases wall corrections are shown to degrade the correlation. The aircraft and wind-tunnel geometry are related to model-tunnel sizing parameters and a VTOL lift parameter, in order to establish tentative sizing criteria for V/STOL wind-tunnel testing with small wall effects. Author

N67-29623# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.

WIND TUNNEL INVESTIGATION OF AN ASPECT RATIO 10 TANDEM WING AIRCRAFT CONFIGURATION IN GROUND EFFECT. PART II. LATERAL CHARACTERISTICS

Lynn A. Trobaugh and Charles W. Harry Jan. 1967 53 p refs

(DTMB-AERO-1111-2; DTMB-2259-2; AD-650998) CFSTI: HC $3.00/MF $0.65

Subsonic wind tunnel test results obtained to determine the lateral aerodynamic characteristics of a tandem wing aircraft model in and out of ground effect are given. Test variables included model height above a ground board, model angle of attack, model angle of sideslip, and center-of-gravity location. Ground effect causes large sideslip-induced rolling moments (dihedral effect) on the model, which can be moderated by altering the size of the vertical tail. It is also possible that the large dihedral effect would be moderated by the roll stiffness term. However, roll stiffness data were not obtained for this model. Author (TAB)

N67-29848# Systems Technology, Inc., Hawthorne, Calif.

CARRIER LANDING ANALYSES Final Report

Tulvio S. Durand Feb. 1967 211 p refs

(Contract Nonr-4156(00))

(STI-TR-137-2; AD-650232) CFSTI: HC $3.00/MF $0.65

The carrier landing process involves the interaction of ship motions, the optical landing system, the pilot/aircraft combination, air wake disturbances, and the Landing Signal Officer. Mathematical models for these elements are formulated, and methods are presented for determining terminal landing errors and resulting operational performance indices. A new concept is described for stabilizing the optical landing system against carrier deck motions. Termed compensated-meatball stabilization, this technique theoretically permits landing operations in more severe sea states through display quickening. The results of simulator experiments support the theory, and additionally show a performance-limiting factor related to the aircrafts lift curve slope. This factor is analyzed and its performance-limiting aspects for both manual and automatic control are delineated. The use of direct lift control (DLC) as a means of overcoming such performance limits is analyzed and discussed. Consideration is also given to the effects of using an idealized, rather than a fixed, glide slope as means of reducing accidents, and to the possible uses of predicted deck position and contingent minimum prediction time and accuracy requirements. Author (TAB)

N67-29881# Aeronautical Research Council (Gt. Brit.)
FLIGHT MEASUREMENTS AT SUBSONIC SPEEDS OF THE AILERON ROLLING POWER AND LATERAL STABILITY DERIVATIVES l_v AND Y_v ON A 60 DEGREE DELTA WING AIRCRAFT (FAIREY DELTA 2)
F. W. Dee London, HMSO, 1964 33 p refs Supersedes RAE-TN-AERO-2897; ARC-25204
(ARC-CP-739; RAE-TN-AERO-2897; ARC-25204) CFSTI: HC $3.00/MF $0.65

The aileron rolling power of the Fairey Delta 2 has been measured at subsonic speeds, by a method using asymmetric wing tip weights. The lateral stability derivatives l_v and y_v have also been determined from measurements in steady straight sideslips. The results have been compared with wind tunnel measurements and some differences found, the tunnel value of $-l_\xi$, for example, being about 20% higher than that measured in flight. The differences could be partially due to aerodynamic interference in the flight tests from the externally mounted wingtip weights. It is hoped to make further tunnel tests with these represented. Author

N67-29892# Wyle Labs., Inc., Huntsville, Ala. Testing Div.
MEASUREMENT OF SONIC BOOM WITH LIMITED FREQUENCY RESPONSE INSTRUMENTATION—A THEORETICAL STUDY
M. J. Crocker Apr. 1966 65 p refs
(WR-66-20)

The modifications of an ideal sonic boom, caused by various measuring systems with different frequency response limitations, are determined analytically. Measurement systems with low pass, high pass, and band pass frequency response characteristics are considered. The approach adopted is to obtain the Fourier transform of an ideal sonic boom by using the System Frequency Response Function to predict the measured time history of the sonic boom. The measured time histories for each system are computed for various system cut-off frequencies. The computations indicate the effects upon the measured peak overpressure and upon the length of the positive and negative phases, due to limitations in frequency response of the measuring system. This work has useful applications in evaluating the accuracy of measurements made of sonic boom and it is recommended that practical measuring systems should have a linear frequency response with lower and upper cut-off frequencies of 0.05 and 10,000 cps respectively. Author

N67-29918# Aeronautical Research Council (Gt. Brit.)
A FLIGHT SIMULATION STUDY OF DIFFICULTIES IN PILOTING LARGE JET TRANSPORT AIRCRAFT THROUGH SEVERE ATMOSPHERIC DISTURBANCES
D. H. Perry and J. Burnham London, HMSO, 1967 68 p refs Supersedes RAE-TR-65195; ARC-27554
(ARC-CP-906; RAE-TR-65195; ARC-27554) HMSO: 11s

A ground based flight simulator, having motion freedoms in pitch and roll, has been used to study the difficulties of flying a representative jet transport aircraft through severe storm turbulence. Random atmospheric disturbances of rms velocity 15 ft/sec, combined with longer term draughts in the vertical plane of up to 200 ft/sec were studied during flight on instruments. Most pilots had surprisingly little difficulty in controlling the aircraft despite the severe conditions represented. Some who made power and trim changes freely, however, tended to set up long period oscillations in speed and flight path, similar to those which have been reported in flight. The results provide a useful experimental demonstration of the validity of current rough air flying techniques. One case of temporary loss of control occurred during the tests and this was attributable to the distraction of the pilot from the main flying task during r/t conversation. Author

N67-29925 Royal Aircraft Establishment, Farnborough (England).
AUTOMATIC LANDING—RECENT R.A.E. CONTRIBUTIONS
B. D. Armstrong Oct. 1966 20 p refs
(RAE-TR-66316)

A review is presented of work on automatic landing during the last four years. Work on roll-out and taxing problems in low visibility and on the pilot's role in an automatic landing are mentioned briefly. The paper dwells particularly on some lessons learned while verifying that the Instrument Landing System (ILS) could be used for landing, and on the implications of the safety target that must be met before blind automatic landing becomes a commercial reality. Author

N67-30025# Advisory Group for Aerospace Research and Development, Paris (France).
SOME PROBLEMS OF FLIGHT QUALITY POSED BY TRANSPORT AIRPLANES WITH SLENDER WING AND NO TAIL-UNIT [QUELQUES PROBLEMES DE QUALITES DE VOL POSES PAR LES AVIONS DE TRANSPORT A AILE ELANCEE SANS EMPENNAGE]
P. Lecomte and E. Fage (Sud-Aviation, Toulouse) May 1966 48 p refs In FRENCH; ENGLISH summary Presented at the 28th Meeting of the Group for Flight Mech., Paris, 10–11 May 1966
(AGARD-532) CFSTI: HC $3.00/MF $0.65

A new generation of fairly large aircraft with slender wing and no tail unit is about to be produced. These aircraft have a number of new features which differ both from those of delta wing fighter aircraft and from those of transport aircraft with moderately swept back wings. Some of these unusual features are analyzed from the point of view of the various tasks to be performed by the pilot and the applicability of certain standard or new criteria is examined. Possible characteristics of lateral stability are fairly well explored and the complexity of the problem and the interaction between the various criteria are illustrated. When discussing longitudinal stability, emphasis is placed on the particularly typical case of the behavior of the aircraft at low speeds. The conclusion is drawn that for these aircraft the critical points are different from those of their predecessors and that the standards for assessing them must quite often be reconsidered. Their stability and control characteristics as a whole, however, although different, compare favorably with those of preceding generations of aircraft. Author

N67-30101# National Aerospace Lab., Tokyo (Japan).
DESIGN AND EXPERIMENTAL STUDY OF AIR JET NOZZLES FOR THE ATTITUDE OF VTOL AIRCRAFT
Naoto Takizawa, Hiroshi Nishimura, Hirotoshi Fujieda, Yoshikazu Tanabe and Akiyoshi Shibuya 1966 25 p refs In JAPANESE; ENGLISH summary
(NAL-TR-123)

An air jet nozzle is indispensable for the hover control of some type of VTOL aircraft. Three air jet nozzles were developed and tested. They showed good thrust characteristics and the most important point in the design of the air jet nozzle is to simplify its mechanism to reduce the weight and driving forces. The last one of the three developed nozzles will be of practical use with minor modifications. Author

N67-30104# National Aerospace Lab., Tokyo (Japan).
ANALYTICAL AND SIMULATION STUDIES ON THE HEIGHT CONTROL SYSTEM OF THE FLYING TEST BED, PART 1
1966 22 p In JAPANESE; ENGLISH summary
(NAL-TR-114) CFSTI: HC $3.00/MF $0.65

The height control characteristics of the lift-jet VTOL aircraft were investigated for the flying test bed (FTB) design. The main difficulties to overcome are identified as stemming from a large time constant of vertical thrust response and a lack of adequate sensing devices for height and vertical velocity. The FTB is equipped with a stability augmentation system (SAS) for the height control.

A feedback of combined signal of vertical acceleration and velocity term, achieved by choosing the time constant of 10 sec, eliminates undesirable effects of a large time constant of vertical thrust response and introduces a quasi damping term in the system. Data indicate that the pilot can control the FTB–SAS–pilot system regardless of the value of the lead time constant. The results were confirmed by simulation tests, and the controllability was considered to be almost the same as that of light helicopters. N.E.N.

N67-30135# Advisory Group for Aerospace Research and Development, Paris (France).
CONSIDERATIONS IN THE DETERMINATION OF STABILITY AND CONTROL DERIVATIVES AND DYNAMIC CHARACTERISTICS FROM FLIGHT DATA
Chester H. Wolowicz (NASA. Flight Res. Center) 1966 190 p refs
(AGARD-549, Pt. I) CFSTI: HC $3.00/MF $0.65

Factors that influence the determination of stability and control derivatives and other behavior characteristics from flight data are considered. Included are illustrations of the application of flight derivatives to verification of predictions and to determination of aeroelastic effects, stability criteria, and flight guidance. Such topics as axis systems and coordinate transformations, equations of motions, mass characteristics, instrumentation, and flight test techniques are discussed. It is concluded that present instrumentation and methods of analysis are adequate for extracting derivatives from flight data for use in most flight guidance simulator studies and detection of characteristics which have not been predicted in the wind tunnel. S.P.

N67-30153*# Republic Aviation Corp., Farmingdale, N. Y.
V/STOL JET OPERATIONS RESEARCH AIRPLANE DESIGN STUDY Conceptual Design Study Report
G. Rosenthal, J. Chung, E. Schiller, and J. Wright 15 May 1967 59 p refs
(Contract NAS1-6778)
(NASA-CR-66420; FHR-3324-20) CSCL 01C

This report summarizes the results of a conceptual design study devoted to tradeoff recommendations for finalized aircraft design requirements. Four new designs and three modified aircraft candidate concepts, and two lift engine models have been evaluated to determine their suitability for a V/STOL jet operations research aircraft. As a result of the parametric study, the General Electric YJ85-GE-19 engine was selected as the most appropriate lift engine to incorporate in both design concepts. In Concept C, two lift-cruise engines are located in the overwing-nacelles and six lift engines are arranged in two longitudinal rows. The aircraft has a hover endurance of 14.0 minutes and a design VTO gross weight of 15,300 pounds. Concept J uses a modified North American stretched Sabreliner airframe with two lift-cruise engines located in the overwing nacelles and eight lift engines arranged in two longitudinal rows in the fuselage close to the center of gravity. In the vertical lift mode a rectangular array of ten jet exhausts is formed by the two lift-cruise engines and the eight lift engines. An evaluation of the new and modified aircraft (Concepts C and J) indicates that Concept C will provide a significant improvement in research utility. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-29038*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
VOLTAGE DISTORTION EFFECTS OF SNAP-8 ALTERNATOR SPEED CONTROLLER AND ALTERNATOR PERFORMANCE RESULTS
David S. Repas and Martin E. Valgora Washington, NASA, Jun. 1967 36 p refs
(NASA-TN-D-4037) CFSTI: $3.00 CSCL 10B

The results of the SNAP-8 alternator tests are presented in this report. This alternator is rated 80 kilovolt-amperes at a power factor range of 0.75 (lagging) to 1.0, 120/208 volts, 400 hertz, and 12,000 rpm. Loads corresponding to typical alternator power outputs were studied to determine the effect of the saturable-reactor–parasitic-load type of speed controller on the harmonics present in the alternator and load voltages. It was found that the maximum total harmonic distortion of the load voltage is 7.5 percent. For certain loads, the alternator kilovolt-ampere rating was exceeded because of the reactive power required by the speed controller. The overload on the alternator can be as much as 13 kilovolt-amperes, or 16 percent. Saturation curves were obtained and the alternator efficiency was determined by the method of separation of losses. Calculated efficiencies from the latter test were compared with data obtained from the alternator manufacturer and were found to agree within 1 percent. Author

N67-29053# Mallory Battery Co., Tarrytown, N. Y.
TESTING AND EVALUATION OF PRIMARY ALKALINE CELLS AND BATTERIES Final Report
Roger Goodman and R. R. Clune Feb. 1967 139 p
(Contract DA-36-039-SC-78320(E))
(ECOM-78320-F; AD-649926)

Testing and evaluating the performance of primary alkaline cells was completed. The cells are of the zinc–alkaline–mercuric oxide system—the 1R, 12R, 42R, 502R, 625R, 640R, 650R, 1438R and 1450R cell-types. The reported areas of performance are: EMF over 36 months of 70°F storage; initial-discharge service from 1/2 to 100-hour rates and at temperatures from −20° to 200°F; and storage reliability and delayed-discharge service for storage temperatures of −20° to 160°F and periods of storage up to 36 months. This for all cell-types. Also, 1000-hour rate delayed-discharge service for the 42R with storage from −20° to 160°F and up to 36 months in length; and service after cyclic-temperature storage for 12R, 625R and 640R cells. Better performance was found in the 42R and 502R for EMF; the 502R and 650R for initial discharge at high temperatures; the 1438R and 1450R for initial discharge at low temperatures; the 42R, 502R, 640R and 650R for storage reliability; and the 42R, 502R, 1450R and 650R for retention of service hours with storage. Author (TAB)

N67-29105# David Taylor Model Basin, Washington, D. C. Applied Mathematics Lab.
COMPUTER PROGRAM DOCUMENTATION STEAM CONDENSER DESIGN
Maxine M. Botting and Denia W. Kelly Jul. 1966 66 p refs
(DTMB-2255; AD-650571) CFSTI: HC $3.00/MF $0.65

The program calculates all the necessary information required for the selection of main or auxiliary steam condensers to either preliminary or contract design requirements. Author (TAB)

N67-29130# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.
INTEGRAL COVERS FOR SOLAR CELLS
J. F. Wise, J. A. McClelland, and R. L. Statler (NRL) [1967] 24 p refs Presented at IEEE 6th Photovoltaic Specialists Conf., Cocoa Beach, Fla., 28–30 Mar. 1967
(AFAPL-CONF-67-8; AD-650114) CFSTI: HC $3.00/MF $0.65

Present integral cover configurations in the 1 to 2 mil thickness range can operate satisfactorily in space for extended time periods. Panel weight reductions of 40 percent are possible for one-year operation in space with a dose equivalent to 10 to the 13th power electrons per square centimeter per day by the use of 4-mil integral covers on thin, drift-field solar cells. A thorough cost-effectiveness analysis of this approach has not been conducted to-date, however. Proper design of these coatings can improve the efficiency of the cells through optimum spectral match and thus eliminates the requirements for adhesives, cover-slip layers, and the associated interference coatings required to reduce ultraviolet-darkening effects on the adhesives. The integral covers exhibit about the same degradation rate as the fused-silica cover slips. These coatings also permit higher temperature operation of solar cells for handling and annealing purposes as well as near-sun mission applications. Author (TAB)

N67-29144*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT POWER
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 23–36 refs (See N67-29141 16-34)

The investigation and initial development of computer programs for solar power system design and analysis are briefly described. An outline is given of the progress in collecting and integrating nuclear codes with necessary cross sections to evaluate shielding problems by calculating neutron and gamma fluxes produced by a radioisotope thermoelectric generator. Continuing applied research in thermoionic energy conversion is summarized, emphasizing (1) the use of CsF vapor in addition to metallic Cs which resulted in a reduction of required cesium pressure, and (2) the effects of inert gas additives on the converter characteristics. N.E.N.

N67-29192# Bendix Corp., South Bend, Ind. Aerospace Div.
CONSIDERATIONS FOR CONTROL OF TOMORROW'S FAMILY OF ENGINES
A. A. Stefucza *In* AGARD Gas Turbines 1966 p 247–262 (See N67-29181 16-28)

The paper identifies the parameters which must be sensed and the ranges of dynamic and steady state performance which are required in order to control the engine under development. These are compared with the requirements for currently operating engines. A hypothetical modern engine which encompasses the most difficult control problems of lift, lift-cruise, and cruise applications is used as a study model. Quantitative expressions of typical response time, parametric and environmental ranges are given for the "difficult parameters". The discussion delineates the matrix of computation technologies, hydromechanical, electronic, pneumatic, mechanical, and hybrid, which could be applied. Interrelation of computation and sensor technologies is indicated. Finally, the "user's problem" is explored from the standpoint of engine and control malfunction detection, component replacement prediction, comparative reliability, and the maintainability at both the squadron and overhaul levels. Author

N67-29193# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
STABILITY OF A LOOP CONTROL OF ROTATIONAL SPEED AND TEMPERATURE OF A VARIABLE NOZZLE REACTOR [STABILITE D'UNE REGULATION A BOUCLE DE VITESSE DE ROTATION ET DE TEMPERATURE D'UN REACTEUR A TUYERE VARIABLE]
A. Stieglitz *In* AGARD Gas Turbines 1966 p 263–273 In FRENCH; ENGLISH summary (See N67-29181 16-28)

In a variable nozzle engine a closed loop control system adjusts the engine speed and temperature by acting on fuel flow and nozzle area. Whilst the speed is measured directly, the turbine entry temperature is obtained by indirect measurement through a ratio between certain engine air pressure parameters. For supersonic aircraft flying at high altitude, this temperature control has a correction loop based on direct thermocouple measurement of turbine exit temperature T4. This trim acts in both directions to maintain a constant T4 temperature as selected through the power lever. In engine partial load conditions, the variable nozzle makes it possible to select the speed and temperature value to obtain the best cruise fuel consumption, and provides the optimum acceleration and surge protection during transient ratings. The control system of this single spool straight flow engine operates similarly for dry operation and reheat. The means used to obtain stable operation of this control with three superimposed loops having a mutual dependence on each other are described, together with response time and control accuracy achieved. Author

N67-29233# Esso Research and Engineering Co., Linden, N. J. Government Res. Lab.
FUEL CELL FUEL STUDIES Interim Technical Report, 10 Jul. 1966–10 Jan. 1967
William J. Asher, Robert H. Shabaker, and Carl E. Heath Feb. 1967 75 p refs
(Contract DA-44-009-AMC-1484(T))
(GR-1-FCF-67; Rept.-2; AD-650580) CFSTI: HC $3.00/MF $0.65

Processes to remove jet fuel components harmful to fuel cell performance were tested in simulated and actual cyclic operation using improved molecular sieves. Improved aromatic absorption performance on the lithium X sieve was achieved by pretreating the sieve with high water loading at elevated temperatures. The adsorption performance of processes using displacing agents, as opposed to burning, for desorption was simulated by preloading sieves with displacing agents. An investigation was also made of the feasibility of reforming high molecular weight fuels in the liquid phase for hydrogen generation for fuel cells. The effects of temperature, pressure, hydrocarbon and water feed rates, hydrocarbon drop size and catalyst geometry on the performance of a fixed bed liquid phase reforming reactor were examined. Good selectivity for hydrogen production has been achieved at low hydrocarbon conversion levels. Preliminary data on the use of palladium diffusers to separate the hydrogen product directly from the condensed phase stream leaving the reforming reactor show substantially lower hydrogen extraction rates are obtained from the liquid phase reformer effluent compared with diffusion from a clean hydrogen stream. TAB

N67-29400*# Battelle Memorial Inst., Columbus, Ohio.
A WATER-VAPOR ELECTROLYSIS CELL WITH PHOSPHORIC ACID ELECTROLYTE
J. E. Clifford, J. A. Gurklis, J. G. Beach, E. S. Kolic, E. W. Winter et al Washington, NASA, Jun. 1967 128 p refs
(Contract NAS2-2156)
(NASA-CR-771) CFSTI: $3.00 CSCL 10C

A program designed to advance the state of the art of a phosphoric acid-type water vapor electrolysis cell which is a potentially attractive subsystem for spacecraft atmosphere control on missions of extended duration; is reported. Two specific objectives of the research program were: (1) reduction of cell voltage, and (2) increase in operational reliability. The current-interruption technique of voltage analysis was successfully applied to the identification of the components of cell polarization. The use of platinized-platinum electrodes reduced the activation polarization and extended operational tests showed that the improvement in cell voltage can be maintained for at least 1000 hours. Operational performance of experimental vapor cells was consistent with the theoretical analysis of operation with respect to fluid dynamics, heat transfer, mass transfer, and electrochemistry. Extended operation with stable voltage characteristics was indicated for cells designed and operated under specified conditions within the normal range of cabin air temperature and humidity. In view of the unique integration of an electrolysis cell in a cabin air conditioning system, further analysis is recommended to define the best cell operating

conditions and to determine whether under these conditions certain apparent problems are sufficiently important to warrant further research. S.C.W.

N67-29450# General Electric Co., Lynn, Mass. Direct Energy Conversion Operation.
HYDROCARBON–AIR FUEL CELLS Technical Summary Report, 1 Jul.–31 Dec. 1966
31 Dec. 1966 42 p refs
(Contract DA-44-009-AMC-479(T); ARPA Order 247)
(TSR-10; AD-649895) CFSTI: HC $3.00/MF $0.65

Detailed information is presented on a continuing research and development program to develop a direct hydrocarbon oxidation-air fuel cell technology. Current work included research on electrocatalysts, multi-component fuels, and investigations with alternate acid electrolytes. An analysis of a direct hydrocarbon/air fuel cell system for liquid fuels is presented. The system represents a view of the upper limit in performance now attainable. Author (TAB)

N67-29547# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A THREE-PHASE POWER SOURCE FOR PARAMETRONS [ISTOCHNIK TREKHFAZNOGO PITANIYA DLYA PARAMETRONOV]
V. Ye Obukhov and A. P. Mikhaylenko 23 Jan. 1967 7 p Transl. into ENGLISH from Russian Patent No. 170785 (Appl. no. 830843/26-24, 15 Apr. 1963) p 1–2
(FTD-HT-66-697; AD-650801) CFSTI: HC $3.00/MF $0.65

The patent describes a three-phase power supply for parametrons. The device contains a source of three-phase oscillation cutoff pulses and a source of continuous pumping oscillations. In order to improve the reliability of parametron operation, the unit contains a voltage regulator which is connected to the parametron fixed bias windings. The parametrons are also connected to the source of oscillation cutoff pulses and continuous pumping oscillations. Author (TAB)

N67-29608# Marine Engineering Lab., Annapolis, Md.
DEVELOPMENT OF DIGITAL COMPUTER PROGRAM FOR STEAM-DRIVEN, FREE-PISTON AIR COMPRESSOR
Robert M. Fox Feb. 1967 84 p refs
(TM-337/66; AD-650959) CFSTI: HC $3.00/MF $0.65

A computer program is described that defines the relationship of geometry, motive force, compressed gases, etc. of a mathematical model for an experimental steam-powered, free-piston air compressor currently under development. It provides a detailed breakdown of all forces and kinetics involved in the compressor operation, including their modes of interaction and their effects on compressor performance. Author (TAB)

N67-29618# Sonotone Corp., Elmsford, N. Y.
OPTIMUM STRUCTURES FOR MINIATURE Ni–Cd SEALED CELLS AND BATTERIES Quarterly Report, 11 Aug.–Nov. 1966
John Herrmann, Stephan Thornell, and Michael Ruberto Mar. 1967 87 p
(Contract DA-28-043-AMC-02361(E))
(Rept.-1; QR-1; ECOM-02361-1; AD-649628) CFSTI: HC $3.00/MF $0.65

Electrochemical investigations were directed toward evaluation of 1.0 A.H. and 4.0 A.H. cylindrical NiCd sealed cells presently manufactured. Cell performance with respect to energy density per unit of weight and volume was determined over the temperature range of -40 to +160F; charge rate was five hours for temperature above 0F, and ten hours for below 0F. Data with Viskon and Pellon separators are given at 80F, +160F, and -40F; and at discharge rates of C/5, 1C, 2C, and 3C. Sintered nickel positive plates containing Ni (OH)2 +5 Co; sintered nickel negative plates containing Cd (OH)2, and pasted negative plates of CdO are also investigated. Mechanical findings on cell proportions, plate areas versus plate arrangements, etc. on a 4.0 A.H. cell were evaluated. Battery configurations on three proposed batteries using cylindrical cells are also discussed and illustrated. Author (TAB)

N67-29699# Los Alamos Scientific Lab., N. Mex.
HIGH DUTY FACTOR RF SOURCES AT 800 MHZ
Donald C. Hagerman [1966] 14 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-8343; CONF-670307-17) CFSTI: HC $3.00/MF $0.65

The proton linear accelerator for the Los Alamos Meson Physics Facility will require 45 one-megawatt, 800-MHz rf power sources. The minimum duty factor requirement is 6% (500 μs pulse 120 c/s); eventually, a 12% duty factor (1000 μs pulse 120 c/s) will be needed. The accelerator structure which is the load for the amplifier has a high Q (typically between 20,000 and 30,000); the amplifier loading is further complicated by a variable beam load which may absorb as much as 30% of the amplifier output. Triodes, klystrons, and crossed-field amplifiers all show promise for this service. The Los Alamos Scientific Laboratory is testing and comparactively evaluating these three rf systems. The systems are described and a discussion of the evaluation program is given. Author (NSA)

N67-29784# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF AN ADSORPTION CESIUM RESERVOIR Summary Technical Report
Dec. 1966 86 p
(Contract AT(30-1)-3842)
(NYO-3842-4) CFSTI: HC $3.00/MF $0.65

In developing a practical long-life thermionic converter with an adsorption-type cesium reservoir, work was directed towards the selection and evaluation of acceptable reservoir materials, reservoir design geometry, and the evaluation of adsorption reservoir performance. Adsorption reservoirs were integrated with operating thermionic converters in two series of performance tests. In the first series, adsorption reservoirs were positioned external to the converters; and in the other, the reservoirs were incorporated within the converter structures. Converters which were supplied cesium by adsorption reservoirs were subjected to life testing. Post-test analysis indicated that: (1) molybdenum matrix reservoirs can be saturated fully with cesium; (2) these reservoirs can be used in long life converters; (3) output power degradation after 700 hours was not attributable to the adsorption reservoir; and (4) the adsorption reservoir tends to compensate for small leaks and improves the reliability of converters. NSA

N67-29809# Aeronutronic, Newport Beach, Calif.
POTASSIUM TURBINE EROSION
Hans D. Linhardt, R. F. Smisek, and F. R. Cheslak 15 Dec. 1966 59 p refs
(Contract AT(04-3)-595)
(SAN-595-2; U-3904) CFSTI: HC $3.00/MF $0.65

Results directed towards the design, fabrication, and testing of a supersonic turbine within the environment of an externally heated, forced convection, boiling-condensing, pressurized closed-loop K facility are summarized. The most prominent feature evident on inspection of the turbine wheel was an erosion groove starting at the leading edge near the root of each blade and then continuing in a radial direction to the blade tip immediately behind the leading edge on the convex side of the blade. In addition, two of the three partial admission turbine nozzles experienced a large amount of what appeared to be corrosion with large deposits visible on the nozzle walls. Due to flow separation, it is believed that a puddle of liquid K accumulated downstream of the corroded nozzle

area, from which large liquid K droplets were shed. The impingement of these secondary droplets upon the turbine wheel would explain the erosion groove on each blade. The small amount of erosion visible on the concave and convex side of the blades near the leading edge is attributed to the impingement of primary or freestream potassium droplets. It is recommended that nozzle corrosion be eliminated by redesign of the nozzles and a more stringent control of the oxygen level during loop operation. NSA

N67-29811# Sundstrand Corp., Rockford, Ill. Aviation Div.
ORGANIC RANKINE CYCLE TECHNOLOGY PROGRAM Quarterly Progress Report, 1 Oct. 1966–1 Jan. 1967
A. Warren Adam 13 Jan. 1967 87 p refs
(Contract AT(04-3)-651)
(SAN-651-16; QPR-3; AER-468) CFSTI: HC $3.00/MF $0.65

Progress on the development of an organic Rankine cycle power system for use in a space environment is reported. The program areas of investigation included the working fluid (biphenyl and the eutectic mixture of biphenyl and biphenyl ether), bearings, pumping system, and boiler unit. NSA

N67-29844 Tasmania Univ., Hobart (Australia).
THE HUB BOUNDARY LAYER OF AN AXIAL FLOW COMPRESSOR
B. A. Russell (M.S. Thesis) Dec. 1966 106 p refs

A detailed study of the hub boundary layer in an axial flow compressor has been made and a model is proposed for the flow on the stationary walls as a quasi turbulent boundary layer in which the eddies have distinct directional properties due to the secondary flow within the rotor. Author

N67-29982* Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
DESIGN AND FABRICATION OF 100 AMPERE-HOUR NICKEL CADMIUM BATTERY CELLS Final Report
F. E. Betz [1967] 80 p
(Contract NAS1-4289)
(NASA-CR-66300) CFSTI: HC $3.00 CSCL 10C

A hermetically sealed 100 ampere-hour nickel–cadmium cell incorporating an active Adhydrode third electrode was designed and developed. The design dimensions of the cell were established to optimize heat transfer characteristics during cell overcharge. The Adhydrode, an auxiliary electrode sensitive to oxygen, enables one to avoid overcharging the cell, decrease the conversion of electrical energy of overcharge into thermal energy, and reduce the cell's operating temperature. Electrical testing was completed on five developmental models at room temperature and 90°F. Testing at 32°F was accomplished on the final design hermetically sealed cells. Cell capacities above 120 ampere-hours were obtained at C rate discharges, and above 130 ampere-hours at C/10 rate discharges. Adhydrode characteristics showed that it is feasible to use the voltage generated by the Adhydrode to signal completion of charge. A resistance of 5 ohms between the Adhydrode and negative terminal provides a high power output with good voltage signal. A voltage signal of 350 millivolts was used to terminate charging at 32°F and a signal of 500 millivolts at 90°F. Author

N67-29996*# Catalyst Research Corp., Baltimore, Md.
DEVELOPMENT OF A LONG LIFE THERMAL CELL Status Report No. 1
H. J. Goldsmith and J. R. Moser 15 Apr. 1967 144 p
(Contract NAS3-8517)
(NASA-CR-72263) CSCL 10C

The main emphasis was on the development of a reliable cathode (14 A hr capacity) and separator. Five cathode configurations and five CuO/Cu_2O chemical compositions were designed and evaluated. Tests resulted in the choice of a copper needle configuration while 100% CuO and 100% Cu_2O gave comparable discharge characteristics. Efficiencies between 80 to 90 percent have been achieved and Vitron E was established as the best separator of the five tested. The report contains conclusions and results of the following tests: potential–current, potential–time, stability, surface area, porosity and solubility of the cathode; stability of the anode; separator resistance and stability; thermal oxidation of copper to CuO and Cu_2O; and soundness of the cell under various dynamic conditions. Work is continuing using full, sealed cells containing 100% CuO and 100% Cu_2O needle cathodes with vitron separator. Author

N67-30026*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR ARRAY REGULATIONS OF EXPLORER SATELLITES XII, XIV, XV, XVIII, XXI, XXVI, XXVIII, AND ARIEL 1
John Paulkovich Washington, NASA, Jul. 1967 23 p refs
(NASA-TN-D-3983) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Presented is a description of how the solar array regulators of various spacecraft differ in design to accommodate the different requirements of nickel cadmium and silver cadmium batteries. Analyzed are regulator requirements for the Ariel I satellite; Explorers XII and XIV; Explorers XV, XVIII, XXI, and XXVI; and the Explorer XXVIII spacecraft. S.C.W.

N67-30055*# Volt Technical Corp., Washington, D. C.
QUANTUM GENERATOR IN SPACE [KVANTOVYY GENERATOR V KOSMOSE]
Z. I. Yur'yev 12 Jun. 1967 5 p Transl. into ENGLISH from Priroda (Moscow), no. 2, 1967 p 72–74
(Contract NAS5-12487)
(NASA-CR-85262; SF-RA-QUE-10821) CFSTI: HC $3.00/MF $0.65 CSCL 09C

The utilization of quantum generators in space is examined. Particular emphasis is given the utilization of molecular generators in the airborne apparatus of the Earth's artificial satellites. The experiment on Kosmos-97 is described. This experiment was with quantum generator using ammonia and to conduct it one the variants of the Kosmos series was applied, i.e., that with solar cells. Author

N67-30067*# Leesona Corp., Great Neck, N. Y.
THE IMPROVEMENT OF ZINC ELECTRODES FOR ELECTROCHEMICAL CELLS Final Report, 12 Jun. 1964–24 Mar. 1965
J. E. Oxley [1965] 40 p refs
(Contract NAS5-3908)
(NASA-CR-85251) CSCL 07D

Present Ag/Zn batteries, when used as secondary batteries capable of sustaining hundreds of charge/recharge cycles, yield only 30 watt hours per pound. The major obstacle preventing an improvement is the deterioration of the zinc electrode which occurs during recharging by the formation of dendrites on the Zn negative plate. Two main parameters which control dendrite growth were identified: (1) the overpotential which governs the morphology, and (2) the rate and type of zincate diffusion (i.e., spherical or linear) in relation to the geometry of the electrode/electrolyte interface, which controls both the overall growth rate and the selective propagation of individual dendrites. It was shown that density differences between zincate and potassium hydroxide, and hydrogen bubble formation both lead to local convection and thereby enhanced propagation. Two remedies were suggested: (1) the use of intermittent charging which was shown to produce a denser and more even deposit, and (2) a method for eliminating preferential edge growth. Author

N67-30140*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DEVELOPMENT OF A 3400 WATT PROGRAMMED DC POWER SUPPLY PROVIDING STATIC AND DYNAMIC SOLAR CELL ARRAY SIMULATION Summary Report
Paul Knauer 15 Nov. 1966 33 p ref
(Contract NAS3-7920)
(NASA-CR-72075; WAED66-60E) CSCL 10B

The primary objective in the design of the solar-cell array simulator was to provide a source of dc power which would be similar, both statically and dynamically, to the output of a solar-cell array. To accomplish the latter, a large number of parallel power transistors operated as a Class-A series regulator were employed as the main controlling element. The solar-cell array volt-ampere characteristics were obtained by utilizing a diode function generator. The simulator operates in a closed-loop mode incorporating both voltage and current feedback. The resulting transient response obtained in the simulator is in the order of 50 microseconds. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-28990# RAND Corp., Santa Monica, Calif.
MATHEMATICAL ANALYSIS AND DIGITAL SIMULATION OF THE RESPIRATORY CONTROL SYSTEM
Fred S. Grodins, June Buell, and Alex J. Bart Mar. 1967 54 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5244-PR; AD-650132) CFSTI: HC $3.00/MF $0.65

The report expresses the basic material balance relationships for the lung-blood-tissue gas transport and exchange system in a set of differential-difference equations containing a number of dependent time delays. Additional equations define the chemical details of transport and acid-base buffering, concentration equilibria, and blood flow behavior. Finally, a control function is included defining the dependence of ventilation upon CSF (H(+)), and arterial (H(+)) and PO2 at the carotid chemoceptors. A Fortran program was written for convenient digital simulation of the responses of the system to a wide variety of forcings, including CO2 inhalation, hypoxia at sea level, altitude hypoxia, and metabolic disturbances in acid-base balance. Both dynamic and steady-state behavior of the model were reasonably realistic. Author (TAB)

N67-29002*# Farnum (Frank C.) Co., Philadelphia, Pa.
OXYGEN BALANCE OF THE BODY DURING EXTENDED ACCELERATIONS [KISLORODNY BALANS ORGANIZMA PRI DLITEL'NYKH USKORENIYAKH]
A. S. Barer, G. A. Golov, V. B. Zubavin, Ye. I. Sorokina, and Ye. P. Tikhomirov Washington, NASA, Jan. 1967 8 p refs Transl. into ENGLISH from a Russian Paper Presented at the 17th Intern. Astronautical Congr., Madrid, 9–15 Oct. 1966
(Contract NASw-1497)
(NASA-TT-F-10682) CSCL 06S

At increasing accelerations (8–12 g) various data collected from white rats and humans show: (1) quickening and increased depth of respiration; (2) decrease in vital capacity by a gradient of ca. 200 ml/g; (3) increase in total oxygen consumption and CO_2 release; (4) increase in % of oxygen in exhaled air and decrease in percentage of CO_2; (5) decrease in HbO_2. There was clear correlation between the longitudinal component of acceleration and the level of circulation in the cerebral vessels (vector at angles of 65° and 80°). Author

N67-29020*# International Information, Inc., Philadelphia, Pa.
THE CIRCULATION DURING ACCELERATION. ROENTGENKYMOGRAPHIC RECORDING DURING CHANGES IN ACCELERATION [DER KREISLAUF UNTER BESCHLEUNIGUNG. RONTGENKYMOGRAPHISCHE AUFNAHMEN BEI BESCHLEUNIGUNGSANDERUNG]
H. Peiffer Washington, NASA, Jun. 1967 16 p refs Transl. into ENGLISH from Luftfahrtmedizin (Germany), v. 3, 1939 p 82–96
(Contract NASw-1499)
(NASA-TT-F-11060) CSCL 06S

Centrifuge acceleration experiments were performed on six monkeys after Thorotrast injections. Kymograms of the heart filling were achieved by using a roentgenykymograph. Within one second after the centrifuge stops, normal conditions prevail in the heart filling. When the centrifuge is started, the filling decreases slowly, and when acceleration is applied for longer periods, the blood accumulates in the liver. The changes in heart filling are primarily dependent on the physical make-up of the animal during increasing acceleration. Author

N67-29098# Raytheon Co., Waltham, Mass.
IN SEARCH OF MATHEMATICS FOR BIOLOGY Final Report, 1 Nov. 1966–31 Jan. 1967
John M. Myers Apr. 1967 63 p refs
(Contract F44620-67-C-0032)
(S-932; AFOSR-67-0893; AD-650404) CFSTI: HC $3.00/MF $0.65

An account is given of the inquiries and reflections of a physicist and applied mathematician who explored problems in biology from the viewpoint that the development of information processing systems of organisms must occur in a sufficiently rule-like way to be mathematically describable. The report considers: (1) bases for the supposition of transformation generating principles that are rooted both in evolutionary and developmental phenomena; (2) a comparison of beginnings of results in artificial intelligence and results of research on relevant biological structure; and (3) efforts to devise new kinds of mathematics for biology. Analogies are discussed between electronic and nervous circuits with the observation that the analogy between the brain and a very fancy circuit is an analogy between a brain which we do not understand and a circuit that is completely outside our experience with circuits and which we do not understand either. Considerations of perception and context lead to the statement that an organism can be taken as the expression of a point of view, and a point of view can be taken as a partitioning of the of the universe into classes of equivalence of response. Thus, a characteristic feature of a mathematical representation of structure would come from the credibility that a point of view attributes to other points of view. Though consideration of relations between points of view led back to those that stem from sets, a set may be an expression of a point of view that is yet, in the biological sense, to be described mathematically. Author (TAB)

N67-29099# RAND Corp., Santa Monica, Calif.
A GENERAL BUILDING BLOCK FOR DIRECT MODELING
Norman B. Reilly Apr. 1967 41 p refs Submitted for publication
(P-3528; AD-650130) CFSTI: HC $3.00/MF $0.65

The direct modeling of a physical process involves the use of empirically defined logical building blocks and their interconnections to mimic the complete observed or postulated behavior of a process. The approach has a number of advantages dealing with the enhancement of intuitive interaction, the bypassing of certain mathematical difficulties, and the minimizing of interruptions. The growing needs for such a tool are reflected in current writings and are discussed in the report. A specific building block is suggested and examples of its application to different problem areas are given. A general discussion deals with questions of economy, mathematics, and physical realization. Author (TAB)

N67-29110# Oxford Univ. (England). Dept. of Human Anatomy.
RECIPROCAL CONTROLS BETWEEN NERVOUS SYSTEM AND ENDOCRINE SECRETION Final Scientific Report, 1 Apr.–30 Sep. 1966
G. W. Harris Feb. 1967 8 p refs
(Grant AF-EOAR-66-10)
(AFOSR-67-0920; AD-651128) CFSTI: HC $3.00/MF $0.65

The investigation was designed to map out some of the forebrain pathways involved in the control of the anterior lobe of the hypophysis. The hypothalamus and parts of the cerebral cortex were stimulated with permanently implanted electrodes and the release of the adrenocorticotropic (ACTH) and of the thyrotropic (TSH) hormones from the pituitary were measured. A technique was developed by which the continuous stimulation of the different parts of the brain can be carried on for days at a time. From such prolonged stimulation, the effects of stimulation should become evident. This is a slow technique, but can be expected to yield information on the effects of over-stimulation of the thyroid gland. This may have immediate practical application, if certain changes occur. Author (TAB)

N67-29127# Bucknell Univ., Lewisburg, Pa.
THE EFFECTS OF FEAR OF FAILURE ON RISK-TAKING AND PERFORMANCE
Richard C. Teevan, Jon Erik Rolf (Minn. Univ.), and Robert C. Birney (Amherst Coll.) Mar. 1967 10 p refs
(Contract Nonr-3591(01))
(AD-650302) CFSTI: HC $3.00/MF $0.65

Three measures of risk-taking and four measures of performance were employed to investigate the effects of fear of failure (FF) on these two variables. All Ss were required to participate in all tests and seven hypotheses were formulated and examined within the general areas stated above. In the area of risk-taking, it was found that as the subjective failure became more intense, the high FF Ss tended to take fewer and fewer risks. Likewise, FF was found to have a debilitating effect on three of the performance tasks employed. The previous finding that high FF Ss set wider confirming intervals (CIs) than low FF Ss was also substantiated. Two questionnaires (Risk-Taking and Performance) were administered in attempts to obtain more direct indices of the effects of FF motivation in these two areas. Neither questionnaire proved to be as successful as the behavioral measures. Author (TAB)

N67-29135# RAND Corp., Santa Monica, Calif.
THE IMPORTANCE OF THE DATA-GENERATING MODEL IN PROBABILITY ESTIMATION
Sarah Lichtenstein (Oregon State Univ.) and George J. Feeney (GE) Apr. 1967 15 p refs
(P-3579; AD-651108) CFSTI: HC $3.00/MF $0.65

When subjects appear to do poorly in a complex probability estimation task, they may be making careful estimates based on a different data-generating model than the one used by the experimenters. Eleven subjects estimated for 150 trials the probability that a dropped bomb had been aimed at one of two cities. Correlations between subjects estimates and probabilities generated by the correct, circular normal model and by a simple, incorrect ratio of distances model showed six subjects using the wrong model with great accuracy. The usual analysis of such data, in which a possible confusion about the data-generation model is disregarded, would have led to the misleading conclusion that these subjects were very inaccurate at the task. Author (TAB)

N67-29137# Texas Univ., Austin. Dept. of Psychology.
ATTITUDINAL EFFECTS OF STRESS AND JUSTIFICATION: A REPLICATION AND EXTENSION
Robert L. Helmreich Apr. 1967 24 p refs
(Contract N00014-67-A-0126-0001)
(TR-3; AD-650310) CFSTI: HC $3.00/MF $0.65

The effects of stress, justification and timing of justification on liking for a dull task were investigated in a 2 X 2 X 2 factorial design. The results under low fear replicated an earlier study by Freedman: when justification was given before performing the task, the lower the justification, the greater the liking for the task; but when justification was given after completing the labor, the less the justification, the less the enjoyment of the task. Under high fear, no significant effects for either justification or timing of justification were found. However, high fear Ss found the task significantly more enjoyable than those under low fear, supporting a view that dissonance aroused by commitment to an unpleasant, forthcoming experience was reduced by positively evaluating the experimental task. Author (TAB)

N67-29159*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIOSCIENCE
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 224–240 refs (See N67-29141 16-34)

Soil properties and abundance of microflora from soil profiles in the desert area of McKelvey Valley, Antarctica are presented. The methods of collecting and homogenizing the soil samples are outlined, along with the physical, physicochemical, chemical, and microbiological analytic techniques, and the data is tabulated. The conclusions include the following findings: The Antarctica soil properties are similar to those for other desert soils. All samples showed properties of a saline soil. Contamination with nonhuman organics could have occurred. Common groups of microflora was low or nil, and much lower than for typical United States desert soils. Mesophiles, microorganisms with psychrophilic capabilities, aerobes, anaerobes, and microaerophiles were present. Details are also given on the redesigning of a hydrogen ionization detector to monitor the products from a differential thermal analysis–effluent gas analysis thermal head assembly. N.E.N.

N67-29205*# International Information, Inc., Philadelphia, Pa.
SPACE BIOLOGY AND MEDICINE
Washington, NASA, Jun. 1967 134 p refs Transl. into ENGLISH of Kosmich. Biol. i Med. (Moscow), v. 1, no. 1, 1967 p 1–94
(Contract NASw-1499)
(NASA-TT-F-11100) CFSTI: HC $3.00/MF $0.65 CSCL 06S

CONTENTS:

1. SOME OF THE MAIN PROBLEMS OF SPACE BIOLOGY AND MEDICINE N. N. Gurovskiy, V. V. Parin, and V. N. Pravetskiy p 1–4 (See N67-29206 16-04)

2. EXPERIMENTAL RESEARCH INTO SPACE PSYCHOLOGY V. V. Parin and F. D. Gorbov p 5–12 refs (See N67-29207 16-04)

3. PROBLEMS OF GASTROENTEROLOGY IN SPACE MEDICINE AND THE PHYSIOLOGICAL BASES OF COSMONAUT NUTRITION I. M. Khazen p 13–22 refs (See N67-29208 16-04)

4. PROBLEMS OF CREATING LIFE SUPPORT SYSTEMS FOR SPACECRAFT B. A. Adamovich and G. G. Ter-Minas'yan p 23–33 refs (See N67-29209 16-05)

5. THE PROBLEM OF SPACECRAFT HABITABILITY Yu. G. Nefedov and S. N. Zaloguyev p 34–42 refs (See N67-29210 16-05)

6. INCREASING THE RADIORESISTANCE OF THE POTATO UNDER CONDITIONS OF ANOXIA V. P. Dadykin, Yu. I. Shaydorov, D. F. Gertsuskiy, I. S. Skukina, T. I. Nikishanova et al p 43–48 refs (See N67-29211 16-04)

7. CHANGES IN THE HEART DURING HYPOXIA (AN EXPERIMENTAL MORPHOLOGICAL STUDY) V. V. Portugalov, O. G. Gazenko, V. B. Malkin, A. S. Kaplanskiy, G. N. Dumova et al p 49–54 refs (See N67-29212 16-04)

8. NEURO REFLEX MECHANISMS CONTROLLING HEMODYNAMIC SHIFTS DURING RAPID AND SLOW INCREMENTS IN ACCELERATION Ye. B. Shul'zhenko p 55–59 refs (See N67-29213 16-04)

9. REACTION OF SOLITARY NEURONS IN THE VISUAL REGION OF THE CAT'S CEREBRAL CORTEX TO STIMULATION OF THE VESTIBULAR APPARATUS M. G. Kutateladze p 60–63 refs (See N67-29214 16-04)

10. SYNTHESIS OF TISSUE PROTEINS IN ANIMALS DURING HYPODYNAMIA I. V. Fedorov, V. N. Vinogradov, Yu. I. Milov, and L. A. Grishanina p 64–68 refs (See N67-29215 16-04)

11. PROBLEMS OF ACCELERATION IN SPACE PHYSIOLOGY A. S. Barer p 69–76 refs (See N67-29216 16-04)

12. RADIATION SAFETY OF MANNED SPACE FLIGHTS (RADIOBIOLOGICAL ASPECTS) Yu. G. Grigoriyev and Ye. Ye. Kovalev p 77–82 refs (See N67-29217 16-04)

13. APPLICATION OF ONBOARD COMPUTERS FOR MEDICAL MONITORING AND INVESTIGATIONS DURING MANNED SPACE FLIGHTS R. M. Bayevskiy p 83–90 refs (See N67-29218 16-05)

14. PROBLEMS OF SELECTING SCIENTIST–ASTRONAUTS P. I. Yegorov, G. P. Mikhaylovskiy, M. N. Korotayev, T. V. Benevolenskaya, N. M. Boglevskaya et al p 91–94 refs (See N67-29219 16-05)

15. PREVENTION OF THE ADVERSE EFFECT OF HYPOKINESIA ON THE HUMAN CARDIOVASCULAR SYSTEM P. V. Buyanov, A. V. Beregovkin, and N. V. Pisarenko p 95–100 refs (See N67-29220 16-04)

N67-29206*# International Information, Inc., Philadelphia, Pa.
SOME OF THE MAIN PROBLEMS OF SPACE BIOLOGY AND MEDICINE
N. N. Gurovskiy, V. V. Parin, and V. N. Pravetskiy *In its* Space Biol. and Med. Jun. 1967 p 1–4 (See N67-29205 16-04)

Some of the major problems encountered in the development of space biology and medicine are outlined. Physiological and psychological aspects of spacecraft crews and habitable environments are discussed in detail. Author

N67-29207*# International Information, Inc., Philadelphia, Pa.
EXPERIMENTAL RESEARCH INTO SPACE PSYCHOLOGY
V. V. Parin and F. D. Gorbov *In its* Space Biol. and Med. Jun. 1967 p 5–12 refs Presented at the 18th Intern. Congr. of Psychologists, Moscow, Aug. 1966 (See N67-29205 16-04)

The authors emphasize the significance of space psychology as an independent branch of science. Historically, they distinguish two stages: the one prior to, and the other following, the first manned space mission. The paper describes tasks involved in astronaut training. It contains the results of investigations performed using different techniques, including methods of group psychology research. Particular importance is attached to clinical models, i.e., diseases which are, to a certain extent, similar to syndromes developing under extreme conditions. Flight studies involve an analysis of the performance and the application of uncomplicated tests. Post-flight investigations combine pre- and inflight research findings. In this connection, new research purposes are mentioned. Author

N67-29208*# International Information, Inc., Philadelphia, Pa.
PROBLEMS OF GASTROENTEROLOGY IN SPACE MEDICINE AND THE PHYSIOLOGICAL BASES OF COSMONAUT NUTRITION
I. M. Khazen *In its* Space Biol. and Med. Jun. 1967 p 13–22 refs (See N67-29205 16-04)

The author reviews the literature and his own findings on physiology and pathology of the gastrointestinal tract in response to stress exposures. Three problems which are of theoretical and practical significance are indicated: (1) effects of space flight factors on the function of the digestive system; (2) role of the digestive system in the development of motion symptoms during space flight; and (3) development of physiological requirements in relation to long duration space missions. Repeated exposures of the human organism to accelerations, hypoxia, and other factors regularly applied following their after-effects result in its pronounced adaptation. The author discusses techniques to prevent digestive disturbances and to maintain homeostatic functions of the human body. Author

N67-29211*# International Information, Inc., Philadelphia, Pa.
INCREASING THE RADIORESISTANCE OF THE POTATO UNDER CONDITIONS OF ANOXIA
V. P. Dadykin, Yu. I. Shaydorov, D. F. Gertsuskiy, I. S. Skukina, T. I. Nikishanova et al *In its* Space Biol. and Med. Jun. 1967 p 43–48 refs (See N67-29205 16-04)

The paper presents a review of the literary data and the authors' findings relative to the utilization of the radioshielding effect of anoxia for plants growing in space greenhouses where they may be exposed to high doses of radiation. The results of experiments performed to study the radioshielding effect of anoxia, if any, when 1-mo-old potato seedlings were exposed to gamma rays are listed. When the doses were low (500 to 1500 rad) anoxia had little if any effect. Its radioshielding effect was very distinct when the doses were high (3000 to 5000 rad). The radioresistance of the potato plants was increased in the oxygen-free environment (nitrogen was substituted for oxygen). This was indicated by the increased potato yield from such plants. Author

N67-29212*# International Information, Inc., Philadelphia, Pa.
CHANGES IN THE HEART DURING HYPOXIA (AN EXPERIMENTAL MORPHOLOGICAL STUDY)
V. V. Portugalov, O. G. Gazenko, V. B. Malkin, A. S. Kaplanskiy, G. N. Dumova et al *In its* Space Biol. and Med. Jun. 1967 p 49–54 refs (See N67-29205 16-04)

A 14 day experiment on mice kept in a pressure chamber at 378 mm Hg showed that acclimatization to hypoxia increased the resistance of the test animals to acute hypoxia and radial acceleration. The test animals exhibited distinct changes of the myocardium and valves. The data obtained indicate that the increase in specific and nonspecific resistance produced by adaptation to hypoxia is no basis for the assertion that hypoxia acclimatization has a favorable effect on the human body. Author

N67-29213*# International Information, Inc., Philadelphia, Pa.
NEURO REFLEX MECHANISMS CONTROLLING HEMODYNAMIC SHIFTS DURING RAPID AND SLOW INCREMENTS IN ACCELERATION
Ye. B. Shul'zhenko *In its* Space Biol. and Med. Jun. 1967 p 55–59 refs (See N67-29205 16-04)

Anesthetized dogs were exposed to transverse (chest-to-back) accelerations of 9 G for 1 min. They were studied for hemodynamic changes in the cases of intact and denervated zones of the carotid sinus. It is concluded that slowly increasing accelerations play an important role in the development of adaptive and compensatory reactions and are of significance for the body tolerance to accelerations. Author

N67-29214*# International Information, Inc., Philadelphia, Pa.
REACTION OF SOLITARY NEURONS IN THE VISUAL REGION OF THE CAT'S CEREBRAL CORTEX TO STIMULATION OF THE VESTIBULAR APPARATUS
M. G. Kutateladze *In its* Space Biol. and Med. Jun. 1967 p 60–63 refs (See N67-29205 16-04)

Effects of vestibular excitation (exposure to 0.1 to 2 G) on the activity of the neurons of the optic cortex were studied in cats. The microelectric technique was used to monitor the neurons. The results obtained were processed by correlation analysis. Despite the change in the frequency characteristics of the neuron pulse activity, no correlation was found between the changes in neuron activity and the changes in acceleration values. This suggests that excitation of the vestibular apparatus produces a nonspecific effect on the optic cortex. Author

N67-29215*# International Information, Inc., Philadelphia, Pa.
SYNTHESIS OF TISSUE PROTEINS IN ANIMALS DURING HYPODYNAMIA
I. V. Fedorov, V. N. Vinogradov, Yu. I. Milov, and L. A. Grishanina *In its* Space Biol. and Med. Jun. 1967 p 64–68 refs (See N67-29205 16-04)

A 10 to 15 day exposure of rats to hypodynamic caused a significant decrease in the rate of protein synthesis in their liver, kidneys, intestinal walls, heart, and skeletal muscles. The rate had not returned to its initial values by the 6th day after the 15-day exposure to hypodynamia. By this time, normalization of the peripheral blood picture had likewise not commenced, nor had the glycogen level in the liver or weight of the adrenals begun to normalize. Author

N67-29216*# International Information, Inc., Philadelphia, Pa.
PROBLEMS OF ACCELERATION IN SPACE PHYSIOLOGY
A. S. Barer *In its* Space Biol. and Med. Jun. 1967 p 69–76 refs (See N67-29205 16-04)

On the basis of data in the literature and his own findings, the author discusses biomedical problems related to the evaluation of human tolerance to accelerations and the development of methods to increase it. An evaluation is made of the primary factors which limit human tolerance to acceleration. In this connection, the significance of oxygen metabolism in vital organs is emphasized. It is shown that tolerance to impact acceleration depends on the strength of different organs and tissues rather than on the pattern of their physiological responses. Author

N67-29217*# International Information, Inc., Philadelphia, Pa.
RADIATION SAFETY OF MANNED SPACE FLIGHTS (RADIOBIOLOGICAL ASPECTS)
Yu. G. Grigoriyev and Ye. Ye Kovalev *In its* Space Biol. and Med. Jun. 1967 p 77–82 refs (See N67-29205 16-04)

Safety criteria with regard to crew irradiation on short and long-term space flights are considered. It is important to evaluate the recovery process after repeated exposure to radiation, to determine the degree of radiation damage during flight, and to develop methods of preliminary estimation of the astronaut's radiosensitivity. When evaluating radiation hazards of prolonged space flights, it is of great significance to estimate the radiosensitivity of biological life-support systems. The data on the effects of 126 to 660 MeV protons on some higher plants are presented. Author

N67-29220*# International Information, Inc., Philadelphia, Pa.
PREVENTION OF THE ADVERSE EFFECT OF HYPOKINESIA ON THE HUMAN CARDIOVASCULAR SYSTEM
P. V. Buyanov, A. V. Beregovkin, and N. V. Pisarenko *In its* Space Biol. and Med. Jun. 1967 p 95–100 refs (See N67-29205 16-04)

Prevention of the adverse effect of the hypokinesia inherent in prolonged space missions on the human cardiovascular system is discussed. On the basis of the literature and their own data, the authors prove the effectiveness of procedures for maintaining good physical fitness at a sufficient functional level of the circulatory system. The procedures involve adequate physical training and rhythmic compression of the limbs. The use of pharmacological agents and moderate hypoxia for the same purpose requires further investigation. Author

N67-29227# School of Aerospace Medicine, Brooks AFB, Tex.
INITIAL OBSERVATIONS ON THE EFFECT OF HYPOBARIC AND HYPERBARIC PRESSURE ON CELL PERMEABILITY, MAY–AUGUST 1966
Albert T. Bernardini and William H. Pryor, Jr. Dec. 1966 10 p refs
(SAM-TR-66-108; AD-648711) CFSTI: HC $3.00/MF $0.65

Observations of the behavior of human red blood cells in osmotic fragility tests carried out under increased or decreased atmospheric pressures resulted in an apparent alteration in the mechanics of solvent exchange or cell permeability, or both. Comparison of the relative hemolysis of human erythrocytes in hypotonic saline at hypobaric and hyperbaric pressures showed an increase and decrease, respectively, in the extent of hemolysis when compared to ground-level controls. Observations showed that a shift of the normal range curve of osmotic fragility for individuals occurred relative to atmospheric pressure changes. Mechanisms involved in hemolytic changes due to ambient pressure changes have not been fully explored, but changes seen are coincidental with, and relative to, increased or decreased atmospheric pressure variations. It is suggested that since erythrocyte permeability has apparently been altered in vitro, similar alterations may be occurring in vivo, initiated by hydrostatic pressure variations. Problem areas for investigation prompted by these assumptions may involve changes in body fluid shifts, drug dosage and assimilation, and other physiologic and pharmacologic aspects for re-evaluation under conditions of altitude or depth. Author (TAB)

N67-29241*# National Aeronautics and Space Administration, Washington, D. C.
THE EFFECT OF SPACE-FLIGHT FACTORS ON FUNCTIONS OF THE CENTRAL NERVOUS SYSTEM
N. N. Livshits, ed. Jun. 1967 305 p refs Transl. into ENGLISH from the book "Vliyaniye Faktorov Kosmicheskogo Poleta na Funktsii Tsentral'noy Nervnoy Sistemy" Moscow, Izd. Nauka, 1966
(NASA-TT-F-413) CFSTI: $3.00 CSCL 06S

CONTENTS:

1. SOME PROBLEMS OF THE EFFECTS OF SPACE-FLIGHT FACTORS ON THE CENTRAL NERVOUS SYSTEM N. N. Livshits p 1–7 (See N67-29242 16-04)

2. EFFECT OF RADIAL ACCELERATIONS ON THE BRAIN TEMPERATURE OF ANIMALS V. Ya. Klimovitskiy p 8–20 refs (See N67-29243 16-04)

3. FUNCTIONAL STATE OF THE OTOLITHIC PART OF THE VESTIBULAR ANALYZER OF GUINEA PIGS AFTER DOUBLE EXPOSURE TO CENTRIFUGATION Z. I. Apanasenko p 21–39 refs (See N67-29244 16-04)

4. EFFECT OF MULTIPLE EXPOSURE TO VIBRATION ON THE FUNCTIONAL STATE OF THE SPINAL REFLEX ARC M. A. Kuznetsova p 40–60 refs (See N67-29245 16-04)

5. EFFECT OF VERTICAL VIBRATION AND NOISE ON THE CONDITIONED REFLEXES OF RATS N. N. Livshits and Ye. S. Meyzerov p 61–74 refs (See N67-29246 16-04)

6. THE FUNCTIONAL SIGNIFICANCE OF CHANGES IN THE BIOELECTRIC ACTIVITY OF THE BRAIN AND ITS OXIDATING CAPACITY DURING VIBRATION L. D. Luk'yanova and Ye. P. Kazanskaya p 75–87 refs (See N67-29247 16-04)

7. EFFECT OF VIBRATION STIMULUS ON THE OXYGEN METABOLISM OF THE BRAIN IN ANIMALS WITH PARTIALLY ELIMINATED AUDITORY AND VESTIBULAR SYSTEMS L. D. Luk'yanova and S. M. Ambrosova p 88–98 refs (See N67-29248 16-04)

8. INVESTIGATION OF THE RELATIONSHIP BETWEEN THE OXYGEN METABOLISM OF THE BRAIN, ITS ELECTRICAL ACTIVITY AND THE CONDITIONED REFLEX ACTIVITY OF ANIMALS AFTER VIBRATION L. D. Luk'yanova, A. V. Kol'tsova, Ye. S. Meyzerov, and Ye. P. Kazanskaya p 99–117 refs (See N67-29249 16-04)

9. RESPIRATORY CHANGE DURING VIBRATION Ye. P. Kazanskaya and L. D. Luk'yanova p 118–121 refs (N67-29250 16-04)

10. EFFECT OF ACUTE X-IRRADIATION ON VENOUS CIRCULATION IN THE CEREBRAL VESSELS OF A RABBIT V. Ya. Klimovitskiy p 122–129 refs (See N67-29251 16-04)

11. CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION IN THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS. I A. P. Korolevskiy p 130–145 refs (See N67-29252 16-04)

12. CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION ON THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS. II A. P. Korolevskiy p 146–157 refs (See N67-29253 16-04)

13. CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION ON THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS. III A. P. Korolevskiy p 158–174 refs (See N67-29254 16-04)

14. COMPARISON OF THE EFFECT OF WHOLE-BODY CHRONIC AND ACUTE GAMMA IRRADIATION ON THE HIGHER NERVOUS ACTIVITY OF WHITE RATS (THE ROLE OF THE TIME FACTOR) Ye. S. Meyzerov p 175–191 refs (See N67-29255 16-04)

15. EFFECT OF CHRONIC GAMMA IRRADIATION ON FUNCTIONS OF THE VESTIBULAR ANALYZER AND THE ROLE OF THE TIME FACTOR IN RADIATION REACTIONS OF THE NERVOUS SYSTEM Z. I. Apanasenko p 192–211 refs (See N67-29256 16-04)

16. COMBINED EFFECT OF DOUBLE EXPOSURE TO VIBRATION AND CHRONIC IRRADIATION ON THE FUNCTIONAL STATE OF THE VESTIBULAR APPARATUS Z. I. Apanasenko p 212–228 refs (See N67-29257 16-04)

17. COMBINED EFFECT OF VIBRATION AND IONIZING RADIATIONS ON THE CONDITIONED REFLEXES OF RATS N. N. Livshits and Ye. S. Meyzerov p 229–243 refs (See N67-29258 16-04)

N67-29242*# National Aeronautics and Space Administration, Washington, D. C.

SOME PROBLEMS OF THE EFFECTS OF SPACE-FLIGHT FACTORS ON THE CENTRAL NERVOUS SYSTEM

N. N. Livshits *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 1–7 (See N67-29241 16-04)

Experimental investigations are reviewed on the effects of vibration, acceleration, and ionizing radiation on the central nervous system and cerebral hemodynamics. Studies of the quantitative patterns and mechanisms of the reactions of the nervous system to repeated vibrational exposures are considered; as are those which concern conditioned reflexes, bioelectric activity of the brain, and metabolic processes. The study of the after-effect period following vibration is noted in this regard. An overview is also presented of the effect of ionizing radiations and dynamic factors in developing radiation safety measures for space flights. Different dose rates, change in radiation spectrum, and combined effects of radiation and other factors are reviewed in terms of changing central nervous system functions. M.W.R.

N67-29243*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF RADIAL ACCELERATIONS ON THE BRAIN TEMPERATURE OF ANIMALS

V. Ya. Klimovitskiy *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 8–20 refs (See N67-29241 16-04)

Temperature under the dura mater was recorded in one dog and six rabbits exposed to radial accelerations on a centrifuge. Temperatures were measured with thermistors to within $3.0 \cdot 10^{-3}$ degrees, and the animals were exposed to repeated daily accelerations of 10 g for 30 sec with 30-min intervals. In rabbits, longitudinal accelerations caused an acute decrease in temperature with an immediate return to normal after stopping. In the dog, the analogous temperature peak was directed upward. After repeated exposures the degree of the reaction first increased and then decreased. This phenomenon can be interpreted as initial adaptation. During transverse accelerations there was a temperature increase of small variability in the dog and rabbit. In most cases, after the end of rotation there was a slow decrease of temperature with a return to normal after 15–20 min. The observed temperature changes are compared with those induced by an increase of inhaled carbon dioxide and with data on cerebral circulation under the same conditions. Author

N67-29244*# National Aeronautics and Space Administration, Washington, D. C.

FUNCTIONAL STATE OF THE OTOLITHIC PART OF THE VESTIBULAR ANALYZER OF GUINEA PIGS AFTER DOUBLE EXPOSURE TO CENTRIFUGATION

Z. I. Apanasenko *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 21–39 refs (See N67-29241 16-04)

The effect of double exposure to acceleration (chest and back, 8 g, 15 min, one day interval) on the functional state of the otolithic apparatus of the guinea pig was investigated. Changes in some myoelectric characteristics of vestibular-tonic hind leg reflexes were of a shorter duration and, in some cases, of a lesser magnitude than those after vibration with similar parameters. The condition of the experimental animals revealed no departure from normal, but analysis of the peripheral blood disclosed insignificant leukocytosis. The effects of space flight, acceleration, and vibration are compared with respect to indexes of the vestibular-tonic reflex. In some cases the effects of space flight reveal vibration and acceleration effects, although they were not fully reproducible. Author

N67-29245*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF MULTIPLE EXPOSURE TO VIBRATION ON THE FUNCTIONAL STATE OF THE SPINAL REFLEX ARC

M. A. Kuznetsova *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 40–60 refs (See N67-29241 16-04)

Guinea pigs exposed to whole-body vertical vibration 10 times in the course of 16 days (70 cps, 0.4 mm, 15 min) exhibited parabiotic phenomena in the defensive flexor reflex arc. An inverse correlation was noted between changes in latent period duration and changes in the intensity of threshold electrical stimulus. In the first part of the period of exposure to vibration, there was a cumulation of vibration effects. In the second part, reflex activity tended to improve. A succession of parabiotic phases takes place in the reflex arc, which is indicative of a transfer from higher to lower inhibition. This phenomenon is thought to be evidence of incomplete adaptation to vibration. Vibration stand noise caused changes in the reflexes of the control animals, but these changes differed greatly from those in the experimental animals. Author

N67-29246*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF VERTICAL VIBRATION AND NOISE ON THE CONDITIONED REFLEXES OF RATS

N. N. Livshits and Ye. S. Meyzerov *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 61–74 refs (See N67-29241 16-04)

Rats were exposed three times to whole-body vertical vibration (70 cps, 0.4 mm, 15 min). The interval between the first and second exposures was 14 days, and between the second and third exposures was 7 days. The control animals were placed near the operating vibration stand at the time the experimental rats were subjected to vibration. The motor alimentary reflexes of both sets of the rats were investigated. In rats with a high initial level of conditioned reflexes vibration caused inhibition, with disruption of the relationship between the level of the conditioned reflexes and the stimulating factor. There were significant individual differences

in the responses of higher nervous activity to vibration. In some animals the conditioned reflexes disappeared entirely under the influence of vibration, whereas in others a decrease was noted. In rats with low initial level of conditioned reflexes vibration caused an increase in the conditioned reflexes, disinhibition of differentiation, and phase phenomena. In the control animals subjected to vibration stand noise the changes in conditioned reflexes were considerably less clearly expressed than in the experimental animals. Author

N67-29247*# National Aeronautics and Space Administration, Washington, D. C.

THE FUNCTIONAL SIGNIFICANCE OF CHANGES IN THE BIOELECTRIC ACTIVITY OF THE BRAIN AND ITS OXIDATING CAPACITY DURING VIBRATION

L. D. Luk'yanova and Ye. P. Kazanskaya *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 75–87 refs (See N67-29241 16-04)

Exposure to whole-body vertical vibration (70 cps, 0.4 mm, 15 min) caused the appearance of a stable locus of excitation in higher regions of the central nervous system of rats, accompanied by increased oxygen consumption and hypersynchronization of low frequency oscillations in the EEG. The phase of generalized excitation and the subsequent concentration of the excitation process are observed in the sensorimotor and visual regions of the cerebral cortex. The compensatory-adaptative mechanisms contributing to the decrease in sensitivity to vibration occur in connection with a decrease in excitation processes. Author

N67-29248*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF VIBRATION STIMULUS ON THE OXYGEN METABOLISM OF THE BRAIN IN ANIMALS WITH PARTIALLY ELIMINATED AUDITORY AND VESTIBULAR SYSTEMS

L. D. Luk'yanova and S. M. Ambrosova *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 88–98 refs (See N67-29241 16-04)

Rats were exposed to repeated whole-body vertical vibration, and oxygen consumption in different parts of the brain was studied. Partial destruction of the vestibular apparatus contributed to the appearance of compensatory-adaptation effects on the indices, without a decrease in the general functional level of the CNS. In experiments on anesthesized animals, direct proof was obtained of the extremely important role of the vestibular apparatus in the perception of vibration. Author

N67-29249*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE RELATIONSHIP BETWEEN THE OXYGEN METABOLISM OF THE BRAIN, ITS ELECTRICAL ACTIVITY AND THE CONDITIONED REFLEX ACTIVITY OF ANIMALS AFTER VIBRATION

L. D. Luk'yanova, A. V. Kol'tsova, Ye. S. Meyzerov, and Ye. P. Kazanskaya *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 99–117 refs (See N67-29241 16-04)

When rats were exposed to whole-body vertical vibration six times a week, changes in different indices of the functional state of the central nervous system had a phase character. A study was made of oxygen consumption in cerebral tissues, total bioelectric activity, very slow oscillations and conditioned reflex activity. The first period (1st–4th vibrations) was characterized by the appearance of postvibration generalized inhibition in the higher parts of the brain. In the second period (after the 4th vibration) a compensatory-adaptative process developed, contributing to relative normalization of functions. The third period (after the 20th–25th vibrations) was characterized by a total decrease in the functional activity of higher parts of the CNS. Author

N67-29250*# National Aeronautics and Space Administration, Washington, D. C.

RESPIRATORY CHANGE DURING VIBRATION

Ye. P. Kazanskaya and L. D. Luk'yanova *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 118–121 refs (See N67-29241 16-04)

External respiration was measured in rats exposed to whole-body vertical vibration at a frequency of 70 cps, amplitude of 0.4 mm, and for an exposure time of 15 min. In the first half of the vibration time there was increase in respiration frequency. No general tendency in responsive reaction could be detected in the second half of the vibration period or in the post-vibration period. It is concluded that the changes in oxygen metabolism induced by vibration are not related to respiratory changes. Author

N67-29251*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF ACUTE X-IRRADIATION OF VENOUS CIRCULATION IN THE CEREBRAL VESSELS OF A RABBIT

V. Ya. Klimovitskiy *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 122–129 refs (See N67-29241 16-04)

Cerebral venous blood flow was measured using thermistors for study of the cerebral surface veins of rabbits exposed to X-irradiation. In one group of animals the back and abdomen were irradiated by a dose of 2000 r. Other animals were exposed to total irradiation of 1000 r. In both cases a decrease in the level of cerebral blood flow was observed in the irradiated rabbits compared to control during the first hours after irradiation. Locally irradiated animals were observed for 6 to 8 hours. Whole-body irradiated rabbits survived after exposure and were observed until their death from radiation sickness. In these animals a second decrease of cerebral blood flow was observed 1 to 2 days prior to death. The data obtained are discussed in relation to the literature concerning the effect of irradiation on general and cerebral hemodynamics. Author

N67-29252*# National Aeronautics and Space Administration, Washington, D. C.

CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION ON THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS, I

A. P. Korolevskiy *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 130–145 refs (See N67-29241 16-04)

The comparative effect of fast neutrons, 510 MeV protons, and gamma irradiation in a dose of 300 rad on the higher nervous activity of mice of the $SS_{67}(B1)$ strain was investigated by the motor drinking conditioned reflex method. Exposure to these types of radiation induced disturbance of both excitation and inhibition processes. Neutron and gamma radiations led to more severe disruption of the excitation process, whereas proton radiation more seriously affected the inhibition process. With respect to effectiveness, the three types of radiation fall on the following scale: neutron > gamma radiation > protons. A parallelism was established between the dependence of disruption of conditioned reflex activity on linear ionization density, and the changes in the indices of the peripheral blood are described. Author

N67-29253*# National Aeronautics and Space Administration, Washington, D. C.

CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION ON THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS, II

A. P. Korolevskiy *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 146–157 refs (See N67-29241 16-04)

A study was made of the comparative effect of fast neutrons and gamma irradiation (Co^{60}) in a dose of 25 rad on the higher nervous activity of mice by using the conditioned reflex drinking method. Acute whole-body neutron and gamma irradiations induced weakening of the processes of inhibition and stimulation. Weakening of the processes of active inhibition and stimulation in mice exposed to neutron irradiation was expressed more clearly than in animals exposed to gamma irradiation. It was found that there is a parallelism between disruptions of conditioned reflex activity, depending on linear ionization density; and changes in the hematological indexes were observed. Author

N67-29254*# National Aeronautics and Space Administration, Washington, D. C.

CHARACTERISTICS OF EFFECT OF DIFFERENT TYPES OF RADIATION ON THE HIGHER NERVOUS ACTIVITY OF SMALL ANIMALS, III

A. P. Korolevskiy *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 158–174 refs (See N67-29241 16-04)

Comparative effects of fast neutrons, 510 MeV protons, and gamma radiations in doses of 150 rad on the higher nervous activity of "August" rats were studied by the motor drinking conditioned reflex method. Disturbances of excitation and inhibition processes were detected in all irradiated animals. Neutron and gamma irradiations resulted in greatest disruption of the excitation process, whereas proton irradiation caused greatest disruption of the inhibition process. Author

N67-29255*# National Aeronautics and Space Administration, Washington, D. C.

COMPARISON OF THE EFFECT OF WHOLE-BODY CHRONIC AND ACUTE GAMMA IRRADIATION ON THE HIGHER NERVOUS ACTIVITY OF WHITE RATS (THE ROLE OF THE TIME FACTOR)

Ye. S. Meyzerov *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 175–191 refs (See N67-29241 16-04)

Two groups of rats were exposed to whole-body gamma irradiation by Co^{60} in a dose of 160 hr. One group was irradiated at a dose rate of 85 r/min and the other at the rate of 6 r/day. The conditioned motor alimentary reflexes and the cell content of the peripheral blood were studied. Acute and chronic irradiations caused similar changes in the conditioned reflexes. According to some data, the disturbances of higher nervous activity were somewhat more severe in rats exposed to chronic irradiation. The difference between the changes in these indices in the irradiated groups were not large, but these changes are considered statistically reliable. Contrary to the reactions of higher nervous activity, the decrease of leukocyte, erythrocyte, and hemoglobin content in the peripheral blood was more sharply expressed in animals exposed to acute irradiation. Author

N67-29256*# National Aeronautics and Space Administration, Washington, D. C.

EFFECT OF CHRONIC GAMMA IRRADIATION ON FUNCTIONS OF THE VESTIBULAR ANALYZER AND THE ROLE OF THE TIME FACTOR IN RADIATION REACTIONS OF THE NERVOUS SYSTEM

Z. I. Apanasenko *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 192–211 refs (See N67-29241 16-04)

Male guinea pigs were exposed to prolonged gamma irradiation with 500 r and a dose intensity of 0.6 r/min. The bioelectric activity of extensors of the rear extremity were investigated before, during, and after adequate stimulation of the vestibular analyzer. Survival rate, weight, and general clinical state of the animals were studied. Prolonged irradiation induces strong and long-term changes of the electromyographic characteristics of the vestibular-tonic reflex for the muscles of the rear extremity. These changes are greater and qualitatively different from those induced by acute irradiation in the same dose. All animals survived, and the severity of radiation sickness and the changes in the peripheral blood are less than after acute irradiation. Author

N67-29257*# National Aeronautics and Space Administration, Washington, D. C.

COMBINED EFFECT OF DOUBLE EXPOSURE TO VIBRATION AND CHRONIC IRRADIATION ON THE FUNCTIONAL STATE OF THE VESTIBULAR APPARATUS

Z. I. Apanasenko *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 212–228 refs (See N67-29241 16-04)

Guinea pigs were exposed to combined vibration, 15 min before and after irradiation, and prolonged gamma irradiation in a dose of 500 r and dose rate of 0.6 r/min. The bioelectric activity of the extensors of the rear extremities before, during, and after adequate stimulation of the vestibular analyzer was studied. The survival rate, number of leukocytes in the peripheral blood, weight, and general clinical state of the animals were investigated. Vibration changes the radiation effects on the electromyographic characteristics of the vestibular-tonic reflexes. These changes were most significant during the first days after the exposure. However, the effects of prolonged irradiation are less affected by vibration than the similar effects of acute irradiation. The number of cells in the peripheral blood, weight dynamics, general clinical state, and survival rate of animals subjected to such combined exposure have no statistically significant difference from the corresponding parameters for prolonged irradiation alone. Author

N67-29258*# National Aeronautics and Space Administration, Washington, D. C.

COMBINED EFFECT OF VIBRATION AND IONIZING RADIATIONS ON THE CONDITIONED REFLEXES OF RATS

N. N. Livshits and Ye. S. Meyzerov *In its* The Effect of Space-Flight Factors on Functions of the Central Nervous System Jun. 1967 p 229–243 ref (See N67-29241 16-04)

Exposure of rats to vertical vibration or vibrostand noise, both followed by 50 rad X-irradiation, was compared with 15-min exposure to vibrostand noise by itself. The rats were exposed three times, with 14 days between the first and second exposures and 7 days between the second and third. In the first week after the combined vibration and X-ray exposure, the vibration effect dominated with respect to all indexes of conditioned motor alimentary reflexes; while in the second week after the first exposure, effects were produced by both vibration and radiation. After the second and third exposures, dominance of the vibration effect was noted by the change in the number of phase phenomena. These experiments show, on the one hand, that an extremely significant increase of conditioned reflexes is possible in the case of combined exposure; and, on the other hand, that the decrease in conditioned reflexes is more clearly expressed after combined exposure than after irradiation alone. M.W.R.

N67-29341# Advisory Group for Aeronautical Research and Development, Paris (France).

LOSS OF VISION FROM HIGH INTENSITY LIGHT

1966 202 p refs Presented at the Symp. on the Aerospace Med. Panel of AGARD–NATO, Paris, 16–17 Mar. 1966 *Its* AGARD Conf. Proc. No. 11

CONTENTS:

1. VISUAL DECREMENT IN HUMANS FOLLOWING THERMONUCLEAR DETONATIONS J. F. Culver (School of Aerospace Medicine) p 23–38 refs (See N67-29342 16-04)

2. WHAT IS THE FUNCTIONAL DAMAGE THRESHOLD FOR RETINAL BURN W. T. Ham, Jr., W. J. Geeraets (Medical Coll. of Va.), and J. J. Vos (Inst. for Perception RVO-TNO) p 39–53 refs (See N67-29343 16-04)

3. VISUAL AND RETINAL EFFECTS OF EXPOSURE TO HIGH INTENSITY LIGHT SOURCES M. M. Zaret and G. M. Grosof (Zaret Foundation, Inc.) p 55–65 refs (See N67-29344 16-04)

4. IMMEDIATE AND DELAYED RETINAL VASCULAR CHANGES FOLLOWING EXPOSURE TO HIGH INTENSITY LIGHT C. T. Dollery, E. M. Kohner, J. W. Paterson, and P. S. Ramalho (London Univ.) p 67–72 refs (See N67-29345 16-04)

5. A STUDY OF EFFECTS OF LASER IRRADIATION ON HEAD AND EYE OF SMALL ANIMALS IN TERMS OF NEURO-MOTOR BEHAVIOR W. H. Kirby, Jr., L. M. Sturdivan (Ballistic Res. Labs.), and J. J. Kovaric (Army Dept.) p 77–87 refs (See N67-29346 16-04)

6. THE TIME COURSE OF FLASH BLINDNESS J. L. Brown (Kansas State Univ.) p 91–107 refs (See N67-29347 16-04)

7. EFFECTS OF SIMULATED RETINAL BURNS ON DETECTABILITY AND LEGIBILITY V. D. Hopkin and T. C. D. Whiteside (Royal Aircraft Establish.) p 109–120 refs (See N67-29348 16-04)

8. PRESERVING VISION DESPITE EXPOSURE TO HIGH INTENSITY LIGHT C. McCulloch and J. R. Elder (Toronto Univ.) p 121–142 refs (See N67-29349 16-06)

9. THE SUCCESS OF U.S. NAVY EQUIPMENT DEVELOPMENT PROGRAMS IN MEETING THE FLASH BLINDNESS PROBLEM J. F. Parker, Jr. (Biotechnology, Inc.) and R. A. Boese (Bureau of Naval Weapons) p 143–158 refs (See N67-29350 16-05)

10. PHOTOCHROMIC SUBSTANCES P. J. Douzou (Centre de Recherches des Armees) p 159–163 (See N67-29351 16-05)

11. THE RELATIVE DANGER OF RETINAL BURN AND FLASH BLINDNESS FOR VARIOUS YIELDS OF NUCLEAR EXPLOSIONS J. J. Vos (Institute for Perception RVO-TNO) p 171–202 refs (See N67-29352 16-04)

12. PREDICTION OF EYE SAFE SEPARATION DISTANCES E. O. Richey (School of Aerospace Medicine) p 203–224 refs (See N67-29353 16-05)

13. RESISTANCE TO FLASH BLINDNESS AND AIRCREW SELECTION A. Mercier and G. Perdriel (Advisory Group for Aeronautical Res. and Develop.) p 225–234 (See N67-29354 16-05)

N67-29342# School of Aerospace Medicine, Brooks AFB, Tex.

VISUAL DECREMENT IN HUMANS FOLLOWING THERMONUCLEAR DETONATIONS

James F. Culver *In* AGARD Loss of Vision from High Intensity Light 1966 p 23–38 refs Sponsored by DASA (See N67-29341 16-04)

Two men who received chorioretinal burns during Operation Fishbowl on Johnson Island were observed by physicians for 24 to 48 hours after exposure to the high altitude, long range, night-time missile-delivered nuclear detonation. Close observations were continued for more than 6 months following exposure from a point located at a slant range of over 30 nautical miles. Immediate visual disturbances were reported by both subjects, and the transient blinding cleared rather rapidly and left a central glowing positive scotoma followed by a small central negative scotoma. Ophthalmoscopic examinations revealed generally similar lesions in both patients. In one patient, the tail-like extension of the scotoma disappeared within 2 weeks, and the central scotoma became slightly smaller after a period of 6 months. In the other case, the scotoma was absolute and central and increased slightly during the 6 months period. Vision was affected in both subjects; the fovea was apparently destroyed in one of the subjects, and his visual acuity upon discharge was 20/60 (6/18) bilaterally. The other patient, with 20/25 (8/7) bilaterally, was returned to duty. M.W.R.

N67-29343# Institute for Perception RVO-TNO, Soesterberg (Netherlands).

WHAT IS THE FUNCTIONAL DAMAGE THRESHOLD FOR RETINAL BURN?

J. J. Vos, W. T. Ham, Jr., and W. J. Geerets (Medical Coll. of Va., Richmond) *In* AGARD Loss of Vision from High Intensity Light 1966 p 39–53 refs (See N67-29341 16-04)

While the simplest method of determining the threshold irradiation dose for a retinal burn is to examine the fundus by opthalmoscopy, there is no guarantee that this threshold coincides with the functional threshold. A reduction of enzyme activity has been shown in the retina below the threshold for ophthalmoscopic or histologically detectable lesions. Interpretation of these data in terms of a quantitative model of enzyme destruction enables the determination of the sensitivity to temperature rise of retinal enzymes, and a closer approach to the problem of functional damage. Author

N67-29344# Zaret Foundation, Inc., Scarsdale, N. Y.

VISUAL AND RETINAL EFFECTS OF EXPOSURE TO HIGH INTENSITY LIGHT SOURCES

Milton M. Zaret and Gerard M. Grosof *In* AGARD Loss of Vision from High Intensity Light 1966 p 55–65 refs (See N67-29341 16-04)

Transient loss of visual function (flash blindness) and irreversible thermal injury of the retina are analyzed quantitatively. The measure selected for flash blindness was bleaching of a significant fraction of the visual pigments, and the criterion for retinal burn was the minimal lesion seen ophthalmoscopically. Threshold retinal radiant exposure as a function of wavelength was determined in each case. The computations showed that for some wavelengths, particularly those emitted by the usual laser sources, the retinal burn threshold may be greatly exceeded before marked "visual" impairment is produced. Author

N67-29345# London Univ. (England). Postgraduate Medical School.

IMMEDIATE AND DELAYED RETINAL VASCULAR CHANGES FOLLOWING EXPOSURE TO HIGH INTENSITY LIGHT

C. T. Dollery, E. M. Kohner, J. W. Paterson, and P. S. Ramalho *In* AGARD Loss of Vision from High Intensity Light 1966 p 67–72 refs (See N67-29341 16-04)

Exposure of the pig retina to intense unfocussed light from a xenon lamp produced immediate and delayed changes in the retina and its vascular bed. Long exposures (40–240 seconds) caused an immediate whitish discoloration of the retina, and fluorescence angiograms at this stage showed intense leakage from capillaries and small arterioles. Closure of the smaller vessels takes place in 30 to 60 minutes, but larger arteries and veins above about 60 μ diameter remained patent at this stage. After 1 to 3 days, hemorrhage occurred in the exposed area. Some larger arteries or veins became occluded, and all became tortuous and dilated. The intensity of these changes is variable and is usually more severe in animals with deeply pigmented retinas. Shorter exposures (20–40 seconds) caused no immediate change in the vessels apart from a few leaking points. Areas of whitish discoloration appeared after 1 to 3 days, and the larger vessels became dilated and tortuous. Regions of dilated capillaries appeared on angiograms. Exposures of less than 20 seconds caused no immediate or delayed damage. Histological observations indicated that patch retinal necrosis occurred in the retina exposed for long periods, but vascular changes occurred in areas where histological changes are confined to swelling and migration in the pigment layer. The vascular changes resemble in some respects those resulting from radiation in other tissues. Author

N67-29346# Ballistic Research Labs., Aberdeen Proving Ground, Md.

A STUDY OF EFFECTS OF LASER IRRADIATION ON HEAD AND EYE OF SMALL ANIMALS IN TERMS OF NEURO-MOTOR BEHAVIOR

William H. Kirby, Jr., John J. Kovaric (Army Dept.) and Larry M. Sturdivan *In* AGARD Loss of Vision from High Intensity Light 1966 p 77–87 refs (See N67-29341 16-04)

Dose, time, and response to focused laser energy to the eyes of mice, rats, and guinea pigs were considered in terms of mortality and effects on neuromotor activity. Results indicate that at the same dosage, blindness occurs if the laser energy is received by the eye and instant lethality results from exposure on top of the head. Very little neuromotor loss resulted from eye shots to white mice at energies as high as 125 joules, although there was complete loss of vision to the injured eye as well as considerable hemorrhage; and for white rats, there appeared to be no loss for energies to approximately 110 joules. For guinea pigs, the higher dosage had to be reached before activity loss resulted. A methodology is suggested for simulating serious eye and neuromotor effects to determine effects on animal performance. M.W.R.

N67-29347# Kansas State Univ., Manhattan.

THE TIME COURSE OF FLASH BLINDNESS

John Lott Brown *In* AGARD Loss of Vision from High Intensity Light 1966 p 91–107 refs (See N67-29341 16-04)

Laboratory studies investigate the effects of flash luminosity, duration, and spectral character; visual acuity requirements of the task to be performed; illumination provided; and relative positions of the retinal images of the task and the flash. By measuring elapsed time between exposure and satisfactory task performance, it is found that illumination of the task is the most significant variable in most cases. By increasing task luminosity, recovery time can be reduced to two or three seconds for flash exposures that do not cause retinal damage. While flash blindness conditions studied in the laboratory may be highly artificial, such experiments do indicate the functional relationship among the relevant variables. Values of recovery times reported in laboratory studies should, therefore, not be considered as having absolute application to field situations; in fact, it has been suggested that recovery in the field may occur faster than in the laboratory, possibly because simulated studies emphasize the worst possible conditions. M.W.R.

N67-29348# Royal Aircraft Establishment, Farnborough (England). Inst. of Aviation Medicine.

EFFECTS OF SIMULATED RETINAL BURNS ON DETECTABILITY AND LEGIBILITY

V. D. Hopkin and T. C. D. Whiteside *In* AGARD Loss of Vision from High Intensity Light 1966 p 109–120 refs (See N67-29341 16-04)

Blind areas in the visual field of human subjects were simulated by use of the afterimage of an intense light source. Ability to perform a legibility task such as reading digits was greatly affected by the size of the blinded area, and by whether it was located in the fovea or the near periphery. Performance of a detectability (search) task was also degraded when there was an experimental blind area in the visual field, but the effects were smaller and related less closely to the size and position of the area. Differences between subjects were large. Author

N67-29352# Institute for Perception RVO–TNO, Soesterberg (Netherlands).

THE RELATIVE DANGER OF RETINAL BURN AND FLASH BLINDNESS FOR VARIOUS YIELDS OF NUCLEAR EXPLOSIONS

J. J. Vos *In* AGARD Loss of Vision from High Intensity Light 1966 p 171–202 refs (See N67-29341 16-04)

Explosions of 3 kT are considered the most dangerous in terms of hazards to vision, although such dangerous explosions will probably not produce retinal burns or overall flash blindness during the daytime. At night, however, an explosion of 3 kT can be expected to produce both the burn and the flash blindness; although the effects will not take place until 10 msec after the explosion. Two adequate means of protecting pilots against night-time explosions exist, and the best protection is offered by automatically closing devices such as electromechanical goggles or phototropic materials. Adequate protection is offered by phototropic glasses which close within 10 msec to density 2, as long as the fireball is not seen with the central vision. Protection from this local flash blindness requires considerably more sophisticated techniques, but such efforts are not considered worthwhile because, even in the case of a dead ahead explosion, parafoveal vision can control the aircraft in an emergency. M.W.R.

N67-29412# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

EFFECTS OF BERYLLIUM SULFATE ON SERUM ALKALINE PHOSPHATASE IN PRIMATES Final Report, Jan.–Dec. 1964

Mildred K. Pinkerton and Ralph F. Ziegler Dec. 1966 14 p refs

(AMRL-TR-66-198; AD-650372) CFSTI: HC $3.00/MF $0.65

The effects of intratracheally administered beryllium sulfate on serum alkaline phosphatase were studied in male Macaca mulatta monkeys. Results showed 80% and 50% inhibition of the serum enzyme at 2 and 4 hours postinjection, respectively. Additional experiments were conducted using aluminum sulfate under identical conditions, and no inhibition of serum alkaline phosphatase was noted. Author (TAB)

N67-29430*# National Aeronautics and Space Administration, Washington, D. C.

AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES, APRIL 1967

May 1967 158 p refs

(NASA-SP-7011(37)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The bibliography contains references announced during April 1967. It concentrates on biological, physiological, psychological, and environmental effects to man during atmospheric or space flights. Related topics are included such as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. N.E.N.

N67-29451# Federal Fire Council, Washington, D. C.

CASE HISTORIES OF DEATHS AND INJURIES FROM CARBON TETRACHLORIDE FIRE EXTINGUISHERS

17 Apr. 1967 13 p refs

(AD-650734) CFSTI: HC $3.00/MF $0.65

The case histories represent incidents where the use of carbon tetrachloride as a fire extinguishing agent has resulted in injury and/or death. This compilation does not represent a complete literature search. There are a total of 16 deaths and 33 injuries from these 27 cases. Author (TAB)

N67-29462# George Washington Univ., Alexandria, Va. Human Resources Research Office.

THE UTILITY OF DATA FROM FIELD PERFORMANCE MEASUREMENT

A. James McKnight Mar. 1967 10 p refs Presented at the 10th Ann. Meeting of the Human Factors Soc., Anaheim, Calif., Nov. 1966 *Its* Profess. Paper 10–67

(Contract DA-44-188-ARO-2)

(AD-649866) CFSTI: HC $3.00/MF $0.65

In conducting field performance measurement, an estimate of individual or group performance is measured with respect to some larger system. Three general points at which researchers frequently fail to apply this measurement objective to the field measurement process are considered: First, in defining the tasks to

be performed, the performance is often unwittingly changed so that it no longer conforms to the goals of the system. Secondly, the ability to obtain an estimate of field performance is frequently degraded by failure to maintain representative sampling in the selection or weighting of performance tasks. Finally, in selecting performance measures the observable system behavior is often abandoned in favor of some judgmental estimate of behavioral effectiveness. This not only leaves the relation of behavior to system goals unknown, but also limits the utility of the data with regard to other aspects of the same system or to other systems. Author (TAB)

N67-29487# North Star Research and Development Inst., Minneapolis, Minn.

EFFECTS OF PHYSIOLOGICAL RHYTHMS ON PERFORMANCE Final Report, 1966–1967

Guy H. Miles 28 Mar. 1967 88 p refs

(Contract AF 49(638)-1604)

(W-74; AFOSR-67-0857; AD-650321) CFSTI: HC $3.00/MF $0.65

A series of four studies was completed to determine the effect of time of day on learning and retention of skills. The four studies covered: (1) performance of well-learned skills; (2) learning and retention of simple perceptual-motor skills; (3) learning and retention of simple verbal skills; and (4) stimulus generalization. The results obtained were incorporated into the Hullian learning theory framework. The results indicate that there is a 24-hour cycle of activation or arousal that has a general effect on learning and retention of skills; this effect is similar to the effect of the drive variable postulated by Hull. For subjects pursuing their usual daily routine, drive level is lowest in the early morning and increases until noon. Drive level declines in the early afternoon with recovery late in the afternoon, then rises until early evening. The effect of this 24-hour variation in drive level is particularly pronounced on conditioned autonomic responses, internal stimulus cues also change systematically on a 24-hour cycle. These cues make up a sufficient portion of the total stimulus to which responses are learned so that they affect the ability of the external stimulus components to elicit the learned response; the response tendency is different when tested at the same time of day that learning took place than when tested at other times of day. Author (TAB)

N67-29492# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.

A SACCADIC SUPPRESSION EXPLANATION OF THE PULFRICH PHENOMENON

George S. Harker 28 Feb. 1967 13 p refs

(USAMRL-718; AD-648389) CFSTI: HC $3.00/MF $0.65

A latency explanation of the Pulfrich phenomenon of binocular vision provides for the seen path with an oscillating pendulum to be symmetrical and at right angles to the line of sight. Since the experience of asymmetries in the seen path of a pendulum, when viewed with one eye filtered, is more the rule than the exception, an explanation which has the potential to provide for both symmetry and asymmetry is to be preferred. A saccadic suppression explanation offers this possibility. A saccadic suppression explanation would provide that vision would be suppressed in the filtered eye first followed by suppression in the unfiltered eye. Both eyes would recover vision simultaneously. The predicted resultant disparate stimulation is consistent in direction with that necessary to the Pulfrich phenomenon. The details of the required stimulation have been checked using simple and compound episcotisters. The results with the episcotisters are consistent with the observed phenomena. Author (TAB)

N67-29500# Akron Univ., Ohio.

RATIONAL AND INTERACTIONAL DECISION-MAKING ROLES IN TASK-ORIENTED GROUPS

Norman F. Washburne and Cecil F. Dermofall [1967] 17 p refs

(Contract Nonr-4302(00))

(TR-4; AD-649824) CFSTI: HC $3.00/MF $0.65

As part of a long term effort to develop and verify a theory that cognitive styles differ according to differential socialization, and that they in turn affect role behavior in task-oriented decision-making groups, this study tested the hypothesis that strategists would tend to emerge as leaders in groups made up of both puzzle-solvers and strategists. The results tend to confirm the hypothesis. TAB

N67-29502# Institute for Research, State College, Pa. Div. of Psychobiology.

DRUG EFFECTS UPON A PERFORMANCE AS A FUNCTION OF DATA INPUT RATE

Paul M. Hurst, Kenneth Perchonok, and Sallyann K. Bagley Feb. 1967 18 p refs

(Contract Nonr-4423(00))

(ONR-H-67-1; AD-649822) CFSTI: HC $3.00/MF $0.65

A fourth experiment was conducted as part of a series designed to test an hypothesis concerning drug enhancement of performance under task-induced stress. The drug conditions included chlordiazepoxide (25 mg.), d-amphetamine (11-17 mg.), placebo and no drug. Other independent variables were latency and input pacing rate. Chlordiazepoxide had a slight tendency to impair performance at both levels of pacing. D-amphetamine confirmed the previously-observed trend to enhance performance at moderate levels of pacing, but significantly impaired it at the extremely high level. Implications are derived for the role of drug effects in filtering strategies. Author (TAB)

N67-29519# Tufts Univ., Medford, Mass. Dept. of Biology.

A HISTOLOGICAL STUDY OF THE CHIMPANZEE EYE Final Technical Report, Sep. 1962–Nov. 1966

Russell L. Carpenter Holloman AFB, N. Mex., Aerospace Med. Div., Mar. 1967 82 p

(Contract AF 29(600)-3554)

(ARL-TR-67-9; AD-650566) CFSTI: HC $3.00/MF $0.65

Thirteen eyes of normal chimpanzees from 1-3/4 to 15 years of age were serially sectioned for histological study. No significant differences related to age could be identified. The chimpanzee eye corresponds closely to the human eye, the chief differences being related to the structures of the anterior chamber angle. Although basically similar to the human, they appear to represent a stage in evolutionary development somewhat less advanced. The canal of Schlemm is a larger and more irregular channel than the human canal, with its endothelial lining interrupted so that its lumen becomes continuous with the trabecular spaces. The scleral trabeculae are of two kinds, coarse and fine. The coarse ones are like the human scleral trabeculae but are fewer. The fine trabeculae are continuous with the delicate fibrous stroma of the ciliary body which extends between the circular muscle fibers and the longitudinal and oblique fibers, thus filling in the vestigial ciliary cleft. The fine fibers resemble those occupying the chamber angle of the human foetus eye before their atrophy deepens the angle. The uveal trabeculae are histologically identical to those of the human eye but are more numerous and nearly twice their diameter. They collectively correspond to the pectinate ligament of lower mammals. The suprachoroidal lamellae are networks of flat branching elastic trabeculae bearing pigment cells. Although this differs from the usual description of the human suprachoroidea, re-examination of human preparations discloses no difference between human and chimpanzee. Author (TAB)

N67-29587# Joint Publications Research Service, Washington, D. C.

APPLICATIONS OF CYBERNETIC MODELING IN MEDICINE AND SOCIOLOGY

V. Galuzns'ka *In its* Recent Develop. in Cybernetics–USSR 29 Mar. 1967 p 6–12 (See N67-29565 16-05)

The application of cybernetic modeling in surgery and general medicine is discussed. It is pointed out that the patient's history can be encoded on punching machines and fed to a computer and that the computer can answer three questions: diagnosis, risk of operation, and prognosis of recovery. In addition, it provides the information on what specific tests should be made to refine the diagnosis. The machine, therefore, solves two problems: it simplifies the physician's work and facilitates the processing of medical information. The application of cybernetic modeling to sociology is also considered, with regard to problems of labor productivity and the increase in crime. L.E.W.

N67-29578# Naval Research Lab., Washington, D. C.
RAPID BIOLOGICAL DETECTION OF SLIGHT VARIATIONS IN A METAL SURFACE
P. J. Hannan and Constance Patouillet *In its* Rept. of NRL Progr. Jan. 1967 p 1–7 refs (See N67-29577 16-34)

A small (350-ml) mass-culture unit has been used to determine the toxicity of metal specimens to growing cultures of *Chlorella pyrenoidosa* (7-11-05). The procedure consists in measuring the oxygen production of a culture in the linear phase of growth before and after the insertion of a small (0.125-inch-diameter) metal specimen into the culture. Any inhibition of oxygen production caused by the test specimen is evident, usually within an hour and often within 15 minutes. Specimens, identical by spectrographic analyses, often exhibit different toxicities, but the replication of results with a single specimen is good. Repeated exposure of a specimen to fresh algal cultures decreases its toxicity, however, which indicates that there is a gradual loss of toxic material through leaching. Evidence that surface composition of the test specimen determines its toxicity is manifest in several ways; for example, mechanical working or buffing of the specimen often restores the toxicity lost through leaching. There is reason to think that the toxicity of a given specimen can be attributed to an active point constituting only a small portion of the surface. Author

N67-29591# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
RAIL TEST TO EVALUATE EQUILIBRIUM IN LOW-LEVEL WIDEBAND NOISE
Charles W. Nixon, Charles S. Harris, and Henning E. von Gierke Jul. 1966 24 p refs
(AMRL-TR-66-85; AD-643315) CFSTI: HC $3.00/MF $0.65

Psychomotor performance on a rail test was measured during free-field exposure to noise at an overall level of 120 dB re 0.0002 dyne per square centimeter. Subjects wore various combinations of ear protectors to obtain experimental conditions of: (1) sound pressure levels equal in both ear canals (balanced condition) and (2) sound pressure level greater in one ear canal than in the other (unbalanced condition). Man's ability to maintain his equilibrium was adversely affected by the unbalanced noise condition. The rail test may be a useful measure of psychomotor performance in intense noise. Future research will be directed to rail test performance in exposure conditions higher than those employed in this study. Author (TAB)

N67-29634# Texas Univ., Austin. Dept. of Psychology.
EFFECTS OF STRESS AND BIRTH ORDER ON ATTITUDE CHANGE
Barry Collins (Calif. Univ., Los Angeles), Robert Helmreich, and Donald Kuiken Mar. 1967 17 p refs
(Contract N00014-67-A-0126-0001)
(TR-2; AD-655015A) CFSTI: HC $3.00/MF $0.65

In a field experiment, the effects of a persuasive communication under high and low stress were assessed. 258 Navy recruits were given a counter-attitudinal communication either under high fear (waiting to go through teargas familiarization) or under relaxed conditions (in their barracks). A mood checklist "take" measure verified that subjects were significantly more frightened in the high stress condition than under low stress. High stress SS showed significantly more attitude change than low stress SS. An interaction between fear and birth order was also found. Later-borns under high fear showed more attitude change than first-borns. Last-borns at least five years younger than their next older sibling (large-gap last-borns) were more similar to first borns than to "small gap" later-borns. TAB

N67-29637# Naval Air Engineering Center, Philadelphia, Pa. Aerospace Crew Equipment Lab.
MODIFIED STETHOSCOPE FOR USE IN AREAS OF HIGH NOISE LEVELS
E. S. Mendelson and Gary L. Kellett 21 Feb. 1967 26 p refs
(NAEC-ACEL-543; AD-649847) CFSTI: HC $3.00/MF $0.65

Copies of a stethoscope which had been modified by medical personnel on an aircraft carrier for use in noisy places, have been evaluated in the fleet and tested in the laboratory. Flight surgeons judged the modification superior to the Navy combination stethoscope and to several other standard types in 15 out of 55 direct comparisons, but the disadvantages of the modified instrument outweighed its advantages. The need for a better noise-excluding stethoscope has been confirmed in this study. Intrinsic deficiencies have been found in the standard devices which were not particularly designed for use in noise. Further work is deemed necessary to develop a more effective and more acceptable stethoscope. Author (TAB)

N67-29659# System Research, Ltd., Richmond (England).
RESEARCH ON CYBERNETIC INVESTIGATION OF LEARNING AND PERCEPTION Final Scientific Report, 1 Sep. 1962–31 Aug. 1966
Gordon Pask Jan. 1967 200 p refs
(Contract AF 18(052)-640)
(AFOSR-67-0861; AD-650290) CFSTI: HC $3.00/MF $0.65

The report describes work on cybernetic models for learning and related processes; it provides simulation data and results from comparative studies of learning in man and in the model. Finally, it refers the reader to publications produced as a consequence of this activity. The main topics are: (1) Simulation of evolutionary processes (capable of interpretation in terms of learning in brains or differentiation within a social aggregate). (2) Artificial Intelligence (or Cognitive Structure) models combined with a resource assignment programme. (3) The experimental control system used in the comparative studies. (4) Brief account of philosophical issues; in particular, the relation between (1) and (2) above. (5) Brief statement of the relation between a cybernetic learning model and a self organizing system. Author (TAB)

N67-29665# Utah Univ., Salt Lake City. Dept. of Psychology.
RESULTS FOR AN ADDITIONAL FOLLOW-UP CRITERION ON A SAMPLE OF AIR FORCE SCIENTISTS
Calvin W. Taylor and Kan Yagi Dec. 1966 16 p refs
(Grant AF-AFOSR-144-63)
(AFOSR-67-0896; AD-651119) CFSTI: HC $3.00/MF $0.65

The report supplements an earlier study (AD-267 832) in which 17 measures of contributions of scientists were used as criteria for validating 130 predictor scores for measuring psychological characteristics of the scientists. This report relates to an additional over-all criterion that was obtained for 80 of the original 107 subjects. The criterion was a 6-man committee rating of the scientist. The Biographical Information Blank was again the best single predictor instrument of the new criterion. Aptitude test scores ranked more significantly than previously. T-test comparisons are given for 30 empirically keyed Biographical scores. None of the scores based on a criterion of status-seeking, organization-man tendencies was significant with respect to the over-all criterion. Likeableness as a member of the research team was the most

important criterion dimension with respect to the over-all criterion. Current organizational status also ranked high. Criterion dimensions of quality of product, originality of product, and creativity ratings had little effect on the over-all criterion rating. Some discussion of these findings and of the explanatory power of the profiles of a scientist's contributions is presented. An analysis of criterion intercorrelations by different sources is presented that shows the complexity of the criterion problem and differences that arise in scores of a scientist's performance dependent on the scorer (the individual himself, immediate supervisors, higher level supervisors, peers). Author (TAB)

N67-29668# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.

SOME OBSERVATIONS AND MEASUREMENTS OF THE PANUM PHENOMENON Interim Report

Charles F. Gettys and George S. Harker 13 Apr. 1967 42 p refs

(Rept.-722; AD-649882) CFSTI: HC $3.00/MF $0.65

The angular separation between the binocular and the monocular line of Panum's limiting case was systematically varied under conditions in which the changes in seen relative depth could be quantified. Stereoscopic, equidistant, and anomalous depth localizations were seen. A criterion of variability of depth localization was utilized to differentiate the mechanism operative in determining the seen depth. When stereopsis is clearly present, depth in Panum's limiting case is predictable and reveals a one-to-one relationship with the angle of lateral separation of the stereoscopic stimuli, i.e., the odd line cooperates in free binocular vision with both of the paired lines to give true stereoscopic depth. The range of angular separation over which Panum's limiting case will give rise to stereoscopic depth is increased by free eye movements well beyond the usually reported limits of Panum's retinal areas. Author (TAB)

N67-29818# Oak Ridge National Lab., Tenn. Health Physics Div.

HEALTH PHYSICS ASPECTS OF SUPERSONIC TRANSPORT

Walter S. Snyder [1966] 18 p refs Presented at the 1st Intern. Congr. of the Intern. Radiation Protection Assoc., Rome, Italy, 5–10 Sep. 1966

(Contract W-7405-ENG-26)

(ORNL-P-2597; CONF-660920-12) CFSTI: HC $3.00/MF $0.65

The ICRP Task Group report estimated, conservatively, that the average dose rate of galactic and solar radiation on a polar route and at 60,000 to 80,000 feet could be as much as 3 mRem/hr. For the great bulk of travelers who make only a few flights a year, this was considered to be well within the limits on exposure of individuals of the population to cosmic radiation as recommended by the ICRP and was not considered to pose a problem. For a courier or crew who continually makes such trips, it was considered to be another matter, and consideration was given to the fact that these people should be classed as radiation workers. It was explained how a schedule of 40 hr/mo in actual flight over high latitudes might entail an average radiation dose of 1.5 Rem/yr; this was considered to be a generally conservative estimate. It was noted that some of the present plans provide for monitoring instruments to be placed aboard aircraft and that these should provide better estimates as to actual radiation doses received. It was also noted by the ICRP Task Group that when time factors and the fraction of the population likely to be involved were taken into account, the contribution to the total genetic load was small. NSA

N67-29922# Franklin Inst., Philadelphia, Pa.

EMPIRICAL HUMAN-FACTORS INVESTIGATION OF DISPLAY DESIGN Final Report

Clifton E. Mayfield Apr. 1967 69 p refs

(Contract FAA/BRD-423)

(SRDS-67-12)

Two experiments are discussed in which alphanumeric formats for aircraft flight information are compared. Both experiments utilized a nonintervention dynamic simulation of air traffic which has been called "microsimulation". The first experiment, performed with low traffic densities, indicated that altitude and climb-descent information could suitably be placed in tabular format, if arranged in order of beacon altitude. In this experiment the target-associated identification always remained in the same position with respect to the target. In the second experiment, a similar tabular format was compared with a full three-line target-associated tag which was flipped to a new position (relative to the target) whenever overwrites were imminent. The only significant differences were related to the variances of conflictions called by the controller subjects with the tag format, yielding larger variability than the tabular format. It is suggested that since this tends to overload the communication channels, the tabular format is at least not inferior to the tag format when traffic densities are high as in this experiment. Author

N67-29923# Federal Aviation Agency, Oklahoma City, Okla. Office of Aviation Medicine.

ADAPTATION TO VESTIBULAR DISORIENTATION IV. RESPONSES TO ANGULAR ACCELERATION AND TO BILATERAL CALORIC STIMULATION FOLLOWING UNILATERAL CALORIC HABITUATION

Ruth Ann Mertons and William E. Collins Jan. 1967 14 p refs

(AM-67-2) CFSTI: HC $3.00/MF $0.65

Angular acceleration tests of the vestibular system transcend clinical caloric tests in revealing adaptation to angular accelerations as experienced in rotary motions, including flight situations. The caloric test is definitely not a substitute for angular acceleration tests. The vestibular system is the system primarily involved in disorientation and vertigo. Adaptation of vestibular responses was obtained by clinical methods (unilateral calorization) and the generalization of this state of adaptation to bilateral (caloric and rotatory) stimulation was examined. Data indicate positive transfer effects for the clinical stimuli but no clear transfer of adaptation occurred with respect to responses elicited by angular accelerations. Further, adaptation of nystagmus by repeated angular accelerations failed to transfer to clinical stimulation. Differences in modes of activation between methods and influences related to stimulation of the gravity receptor were cited as possible causes for the lack of transfer. A subject's state of adaptation to angular accelerations may not be adequately assessed by clinical caloric tests. Author

N67-29970# Electrotechnical Lab., Tokyo (Japan).

REVIEW ON COLOR MATCHING FUNCTIONS

Yoshio Sugiyama, Mamoru Suzuki, and Masahiro Fuwa Dec. 1966 112 p refs In JAPANESE; ENGLISH summary

(Rept.-159) CFSTI: HC $3.00/MF $0.65

The color matching functions of the 2° field was recommended by the Commission Internationale de l'Eclairage and its session in 1931, and those for the 10° field was also recommended similarly in 1963, as a supplement to the former ones. The important literatures concerning these color matching functions are summarized, an emphasis being placed on the experiments by Guild and by Wright, and the mathematical transformations by Guild, Smith and Judd, both made for the determination of the 2° field functions, and on the experiments by Stiles and by Speranskaya for the determination of the 10° field functions. In appendices, the methods for the measurement of the relative luminous efficiency function, which is in close connection with the color matching functions, are explained, and the report of Gibson and Tyndall, which has given the basic data to the relative photopic luminous efficiency function adopted in 1924, is collected. Author

N67-29079# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD SEPTEMBER–DECEMBER 1966 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE SETTEMBRE–DICEMBRE 1966]
30 Sep. 1966 104 p refs In ITALIAN; ENGLISH summary
Lectures held in Rome, Sep.–Dec. 1966
(ISS-66/50) CFSTI: HC $3.00/MF $0.65

Conference papers are presented in the following areas of research; genetics and RNA–DNA, bacteriophage and bacteria, irradiation and food, and the central nervous system; current algebra; nuclear structure, elementary particles, particle decay and production, and nuclei; quantum electrodynamics; and magnetic resonance. N.E.N.

N67-29980# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
LINES OF RESEARCH IN BIOLOGICAL PHYSICS [LINEE DI RICERCA IN FISICA BIOLOGICA]
M. Ageno 25 Feb. 1967 89 p refs In ITALIAN; ENGLISH summary Presented at Natl. Acad., Lincei, Italy, 11 Mar. 1967
(ISS-67/5) CFSTI: HC $3.00/MF $0.65

Biological physics is defined as a complex of theoretical observations and experimental research which forms a connection between the basic sciences and previous findings, largely logically independent of the biological sciences. The general methods available for carrying out the program of biological physics are then discussed; and, in particular, the one which consists in substituting for the real systems being studied greatly simplified models, which can therefore be calculated, and which have preserved from reality only the aspects essential to the phenomena involved. Following these general remarks, two examples are described in detail to illustrate what has been said. The first of these examples is the problem of the mechanics of DNA, where a connection between biological facts and basic science is clearly possible and depends only on sufficient theoretical and experimental work. In the second example, computers are used in medical diagnoses. Author

N67-30004*# Naval School of Aviation Medicine, Pensacola, Fla.
SERIAL ELECTROCARDIOGRAMS: THEIR RELIABILITY AND PROGNOSTIC VALIDITY OVER A 24-YEAR PERIOD
William R. Harlan, Jr., Albert Oberman, Ashton Graybiel, Robert K. Osborne, Robert E. Mitchell et al Mar. 1967 27 p refs
(NASA Order R-136)
(NASA-CR-85241; NAMI-999) CFSTI: HC $3.00/MF $0.65 CSCL 06P

Electrocardiographic durations, amplitudes, and vectoral orientations at each of four evaluations in a group of men followed from 24 to 49 years of age were similar to values from cross-sectional surveys of men at the same ages. The pattern of QRS deflections did not change although there were changes in the amplitude of these deflections. A significant decrease in QRS and T amplitude (ΣQRS and ΣT) was found with increasing aging and did not correlate significantly with weight and blood pressure. The QRS axis moved leftward as the group became older and the change in QRS axis was related to interval weight changes and to blood pressure. The T axis and the QRS-T angle did not change during the 24 years of study. The group in whom coronary heart disease subsequently developed had a greater decrease in QRS amplitude and tended to have a greater leftward movement of the QRS vector. The resting electrocardiogram is a reliable measurement despite minor serial changes in amplitude and vectoral orientation but has limited predictive value in men below the age of 50 years. Author

N67-30005* Public Health Service, Cincinnati, Ohio.
ECOLOGY AND THERMAL INACTIVATION OF MICROBES IN AND ON INTERPLANETARY SPACE VEHICLE COMPONENTS Quarterly Report, Jan. 1–Mar. 31, 1967
Robert Angelotti Apr. 1967 16 p refs
(NASA Order R-36-015-001)
(NASA-CR-85238; QR-8) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The dry heat resistance of *Bacillus subtilis* var. *niger* spores in and on various materials was determined. D values for spores encapsulated in epoxy and exposed to temperatures of 115, 125, and 135°C were found to be respectively: D_{115} = 16.1 hours, D_{125} = 5.3 hours, D_{135} = 1.9 hours. The z_D value for spores in epoxy was 21.4 Centigrade degrees with a 95% C.I. of 20.8 to 22.1 Centigrade degrees. D values for spores trapped between stainless steel surfaces mated at 12 and 150 inch-pounds and exposed to 135°C were found to range respectively: D_{135} for 12 inch-pounds = 7.9 to 8.1 minutes and D_{135} for 150 inch-pounds = 22.0 to 25.5 minutes. Inoculated Lucite powders that were stored for two weeks at relative humidities of 20, 40, 60, and 80% and then formed into rods and exposed to 135°C were found to have D values of 73.5, 88.7, 67.4, and 36.0 minutes, respectively. Author

N67-30048*# National Aeronautics and Space Administration, Washington, D. C.
VARIABILITY OF RESPIRATORY FUNCTIONS BASED ON CIRCADIAN CYCLES
Karl E. Schaefer and James H. Dougherty, Jr. 22 Nov. 1966 18 p refs
(NASA Order R-24)
(NASA-CR-85267; Rept.-486; AD-649641) CFSTI: HC $3.00/MF $0.65 CSCL 06P

No systematic study of circadian cycles of lung functions has been reported in the literature in which environmental influences were ridigly controlled. In this study, vital capacity, inspiratory capacity, expiratory reserve volume, maximum expiratory flow rate and maximum inspiratory flow rate were measured four times daily at four-hour intervals in two subjects during a control period, during nine days of isolation in a constant environment, and during a three-day recovery period. Temperature was kept at 27°C plus or minus 0.1 degree, barometric pressure 30.560 plus or minus .004 inches. All the lung functions measured showed circadian cycles which shifted during the isolation period in the same direction as sleep-wakefulness cycles, but at a somewhat different rate. Periodicities were determined with computer analysis using a cross-correlation technique with a synthesized 24-hour sinusoid. Average daily variability of lung functions based on circadian cycles ranged from 5.6 plus or minus 1.7% for vital capacity to 20.3 plus or minus 10.4% for maximum inspiratory flow rate. Author (TAB)

N67-30065*# Naval School of Aviation Medicine, Pensacola, Fla.
CONSTITUTIONAL AND ENVIRONMENTAL FACTORS RELATED TO SERUM LIPID AND LIPOPROTEIN LEVELS
William R. Harland, Jr., Albert Oberman, Robert E. Mitchell, Ashton Graybiel and Robert J. Wherry, Jr. 2 Mar. 1967 29 p refs
(NASA Order R-136)
(NASA-CR-85249; NAMI-1000) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Serum lipoproteins and lipids, in 657 men (age 48) were correlated with multiple constitutional and environmental variables. The lipoprotein groups Sf 0-12 and Sf 20-400 had a low intercorrelation and each correlated with different factors. Sf 0-12 lipoproteins were related to constitutional obesity, cigarette smoking, and family history of vascular disease. The Sf 20-100 and Sf 100-400 lipoproteins related to acquired obesity, carbohydrate tolerance, aggressiveness, and sociability. Carbohydrate tolerance, obesity, and personality were apparently independent variables. Serum

triglyceride levels correlated with the same variables as the Sf 20-400 lipoproteins; serum cholesterol levels were related to factors that correlated with both lipoprotein groups. The prevalence of familial hyperlipidemias was low, but 18 per cent of individuals with elevated cholesterol and a high risk of coronary heart disease could be tentatively classified as having a type of familial hyperlipidemia. Author

N67-30066* Cincinnati Univ., Ohio. Dept. of Pathology.
THE COMPARATIVE RATES OF ISOLATED MYOCARDIAL CELLS
Carl E. Grinstead, II and B. Black-Schaffer [1964] 12 p refs
(Grant NsG-75-60)
(NASA-CR-85250) CSCL 06A

The individual myocardial cells of newborn mice, rats, and rabbits were separated with trypsin and cultured at 37°C. After the cells were incubated for 24 hours, they had autonomous contractions, averaging 74, 55, and 139 per minute respectively in the mouse, rat, and rabbit. These in vitro rates contrast to their respective in vivo heart rates of 500, 400, and 300 per minute. The heart rates of these mammals were found to be independent of the in vitro, single, myocardial cell rate. Author

N67-30068*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
BIOCHEMICAL AND PHYSIOLOGICAL EVALUATION OF HUMAN SUBJECTS IN A LIFE SUPPORT SYSTEMS EVALUATOR
Bernard J. Katchman, George M. Homer, Winslow W. Blanchard, and Dorathea P. Dunco Wright-Patterson AFB, Ohio, AMRL, Feb. 1967 72 p refs
(NASA Order R-85; Contract AF 33(657)-11716)
(NASA-CR-85252; AMRL-TR-66-159) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A 6-week study with four college students as volunteer subjects was conducted for the purpose of evaluating the nutritional requirements of individuals undergoing stresses imposed by simulated aerospace conditions. A 4-day cycle diet of fresh foods was served at room temperature each day; it was comprised of 110 g of protein, 315 g of carbohydrate, 80 g of fat, and 2621 calories. All the clinical data were in the normal range and no significant differences were observed between control and confinement in the Life Support Systems Evaluator. Metabolic balances show excellent adjustment to the diet; all subjects were in positive nitrogen balance. Physiological measurements of heart rate, blood pressure, and oral temperature were in the normal ranges. Minimal body weight changes were observed, indicating that the diet was adequate. The diet was only moderately acceptable because all food was served at room temperature; gravy and cream sauces were rated least acceptable for this reason. Author

N67-30075*# Woods Hole Oceanographic Institution, Mass. Dept. of Chemistry.
SEPARATION OF PROTEINS IN MOLLUSC SHELLS BY GEL-FILTRATION
E. L. Degens, B. W. Johannesson, and R. W. Meyer [1967] 5 p refs
(Contract NSR-22-014-001)
(NASA-CR-85259) CFSTI: HC $3.00/MF $0.65 CSCL 06A

To test an assumption on the formation of mineral nuclei, mollusk shell tissues of widely different biochemical composition and phylogeny were studied by means of enzymatic and non-enzymatic degradation techniques and by gel-filtration. Tryptic digests did not result in the dissolution of shell matrix proteins but treatments with urea, hydroxylamine and formic acid degraded the tissues. A flow diagram depicts the analytic scheme used in this investigation, and it indicates that throughout the molluscan phylum the urea/hydroxylamine fraction is consistently enriched in aspartic acid, lysine and amino sugars although this relationship is not necessarily displayed when these three amino compounds are highly concentrated in the original shell. R.U.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-29091# Admiral Corp., Chicago, Ill.
X-RAY MOTION MONITOR: LOW-DOSAGE, WIDE-VARIABLE-FIELD TELEVISION RADIOGRAPH FOR BIODYNAMIC ANALYSIS Final Report, May 1964–Dec. 1966
William Leyath and Edmund B. Weis, Jr. (AMRL) Wright-Patterson AFB, Ohio, AMRL, Dec. 1966 44 p refs
(Contract AF 33(615)-1878)
(AMRL-TR-66-104; AD-650481) CFSTI: HC $3.00/MF $0.65

The X-Ray Motion Monitor provides a new and versatile tool for experiment and research work in the field of biodynamics. The equipment essentially consists of a pulsed x-ray source synchronized with a closed circuit TV system, utilizing a fluorescent intensifying screen to convert the x-rays into a visible pattern. The head portions of the equipment are designed to withstand acceleration up to 147 meters/sq sec while rigidly mounted to a test platform, and up to 392 meters/sq sec on special shock fixtures designed for drop tests. The light output of the fluorescent screen is matched with the spectral response of the image orthicon tube in the TV camera to provide peak performance while employing extremely low x-ray dosages. The x-ray source is pulsed on for only 1/16 of the total observation time (1 millisecond for every 16.7 milliseconds). The system permits visual observation, and/or cine or video tape recording, of an x-ray view up to a size of 20 by 30 inches of the internal organs of a live test subject while under acceleration or shock. In addition, special video processors in the system provide voltage analog outputs corresponding to the movements of selected internal targets in relation to some fixed internal or external reference points. These analog signals can be recorded by graphic recording devices for reference and later analysis. Author (TAB)

N67-29101# Naval Submarine Medical Center, Groton, Conn. Submarine Medical Research Lab.
THE RESPONSE ANALYSIS TESTER (RATER) AND LOGICAL INFERENCE TESTER (LOGIT): I. SOME PRELIMINARY FINDINGS
James W. Parker 2 Feb. 1967 20 p refs
(SMRL-487; AD-650182) CFSTI: HC $3.00/MF $0.65

The report presents the results of preliminary work with two performance testing devices. One (RATER) measures choice reaction time or the time required to respond to four different colored lights presented in random order for five minutes by pressing the corresponding correct button. The other device (LOGIT) measures the ability to solve problems concerned with determining the correct sequential order in which twenty buttons are pressed in order to light the board. Data are presented for comparing the scores for any group tested on the RATER with a typical Navy population. Results with LOGIT show it to be potentially useful for detegnining performance decrements during exposure to unusual environments, such as high pressure, confinement, or Helium-oxygen breathing mixtures. Author (TAB)

N67-29128# Human Factors Research, Inc., Santa Barbara, Calif.
TEMPORAL PATTERNS OF SIGNALS AND VIGILANCE PERFORMANCE
James F. O'Hanlon, Jr. and James J. McGrath Mar. 1967 41 p refs
(Contract DA-49-193-MD-2743)
(TR-719-3; AD-651047) CFSTI: HC $3.00/MF $0.65

The role of temporal expectancy in vigilance performance was studied by comparing the performances of subjects who were presented with different temporal patterns of signals. Also studied was the effectiveness of displaying a subjects record of responses over time for the purpose of allowing him to anticipate signal occurrences. Finally the relationship between the subjects performance and rates of subjective time was studied to confirm an earlier finding. To accomplish this, different groups of subjects were given simple, complex and random patterns of signals in daily vigilance tasks for five days. Half of each group used a graphic recorder showing a record of their responses over time and half did not. Their rates of subjective time were measured each day. On the last day all subjects were given their normal pattern during the initial period of the vigilance task but were then switched to the random pattern for the remainder of the task. Findings were: (1) the subjects did not respond to the temporal arrangement of signals but may have responded to the mean and variance of intersignal intervals in the patterns, (2) the graphic recorder interfered with, rather than improved, performance, (3) the abrupt change in pattern on the fifth day had a strong deleterious effect upon the performance of those who had learned the initial pattern, and (4) the subjects performance was related to their rates of subjective time in the expected manner. Author (TAB)

N67-29209*# International Information, Inc., Philadelphia, Pa.
PROBLEMS OF CREATING LIFE SUPPORT SYSTEMS FOR SPACECRAFT
B. A. Adamovich and G. G. Ter-Minas'yan *In its* Space Biol. and Med. Jun. 1967 p 23–33 refs (See N67-29205 16-04)

A discussion is presented on the main problems related to life-support systems for spacecraft. Their quality will determine the health and performance of the crew and, consequently, the fulfillment of the mission. Some advanced life-support systems are outlined and approaches in current research that may help to solve the problems are presented. It is shown that these problems can be solved on the basis of the combined efforts of specialists in medicine, biology, chemistry, and engineering. Author

N67-29210*# International Information, Inc., Philadelphia, Pa.
THE PROBLEM OF SPACECRAFT HABITABILITY
Yu. G. Nefedov and S. N. Zaloguyev *In its* Space Biol. and Med. Jun. 1967 p 34–42 refs (See N67-29205 16-04)

A formula is proposed for estimating the composition of the atmosphere in an enclosed space. Studies have indicated that the standards for maximum permissible levels of trace contaminants be based on maintaining a definite difference in the partial pressures of these contaminants in the exhaled air and the air of the sealed compartment. This will preclude accumulation of trace contaminants in the human body. Further studies should be concentrated on the biological compatibility of crew members in view of individual differences in human metabolism and microflora. Author

N67-29218*# International Information, Inc., Philadelphia, Pa.
APPLICATION OF ONBOARD COMPUTERS FOR MEDICAL MONITORING AND INVESTIGATIONS DURING MANNED SPACE FLIGHTS
R. M. Bayevskiy *In its* Space Biol. and Med. Jun. 1967 p 83–90 refs (See N67-29205 16-04)

The principles of developing diagnostic algorithms as applied to onboard computers are considered. Data on the necessary frequency of quantization of some physiological parameters to be fed into the digital computer are presented. Possibilities of machine analysis and logical evaluation of biomedical information are discussed. It is proved that deterministic algorithms can be applied to develop programs for automatic medical monitoring. Some other types of algorithms, e.g., probabilistic, scanning, self-learning, etc., are described. The procedure of programmed biomedical studies involving the onboard digital computer is shown. It is emphasized that the application of algorithm and programming techniques to solve diagnostic problems is of great importance for the development of efficient onboard systems of automatic biomedical monitoring and investigations. Author

N67-29219*# International Information, Inc., Philadelphia, Pa.
PROBLEMS OF SELECTING SCIENTIST–ASTRONAUTS
P. I. Yegorov, G. P. Mikhaylovskiy, M. N. Korotayev, T. V. Benevolenskaya, N. M. Boglevskaya et al *In its* Space Biol. and Med. Jun. 1967 p 91–94 refs (See N67-29205 16-04)

The present stage of development of astronautics necessitates the active participation of highly qualified scientists in space missions. In this connection, space medicine encounters a new problem—to develop scientific criteria for selecting scientist–astronauts. This problem involves a study of the age of candidates and their physical fitness. This article emphasizes the significance of the multi-faceted examinations using functional tests to elicit both latent pathology and functional limitations of the human body. The paper indicates the importance of establishing a correlation between the state of the central nervous system and functional abilities of the organism during functional tests, as well as the correlation between vestibular stability, optic sensitivity, and the state of the autonomic nervous system. Author

N67-29349# Toronto Univ. (Ontario). Banting Inst.
PRESERVING VISION DESPITE EXPOSURE TO HIGH INTENSITY LIGHT
Clement McCulloch and John R. Elder *In* AGARD Loss of Vision from High Intensity Light 1966 p 121–142 refs (See N67-29341 16-04)

Preliminary experiments suggest that shading of areas of the retina, particularly the macular region, can provide considerable protection from glare. In fact, in combination with proper engineering of the task to be performed, shading of part of the retina can permit continuous and efficient performance both before and after exposure to bright light. Results presented for light levels in the region of 5,000 foot lamberts indicate protection of central vision when (1) an area 5° to each side of fixation was shaded from the dazzling light and (2) the dazzling light was eccentrically placed to clear the fixation point by 5°. When the dazzling light was obliquely placed, before one side of the retina only, recovery was slower on that side than on the unexposed side. M.W.R.

N67-29350# Biotechnology, Inc., Arlington, Va.
THE SUCCESS OF US NAVY EQUIPMENT DEVELOPMENT PROGRAMS IN MEETING THE FLASH BLINDNESS PROBLEM
James F. Parker, Jr. and Roland A. Bosee (Bureau of Naval Weapons) *In* AGARD Loss of Vision from High Intensity Light 1966 p 143–158 refs (See N67-29341 16-04)

Efforts by the United States Navy to combat the flash blindness problem are reviewed from an historical viewpoint. Initial efforts were with fixed density visors to attenuate light so as to prevent retinal burns and reduce the severity of flash blindness. Another early project was aimed at providing protection from the thermal effects of a weapon. A low transmission gold-coated visor system, which is considered adequate for daytime protection, is described; and attention is given to current efforts to produce a satisfactory device for protection at night. The comprehensive training program for disseminating information about flash blindness and proper use of protective equipment is discussed. M.W.R.

N67-29351# Centre de Recherches des Armees, Paris (France).
PHOTOCHROMIC SUBSTANCES
P. J. Douzou *In* AGARD Loss of Vision from High Intensity Light 1966 p 159–163 (See N67-29341 16-04)

Highlights are presented of the use of photochromic substances as protective agents against dazzle, and some of the problems associated with the excitation of light are noted. It is noted that the electronic and molecular mechanisms acting in photochromism are complex, and that the medium plays a very important role in the intramolecular reaction. Secondary bimolecular or trimolecular reactions giving rise to free radicals and chain reactions are always observed during photochromism. The photochromic substances considered in the present discussion were derived from the family of spiropyrans. M.W.R.

N67-29353# School of Aerospace Medicine, Brooks AFB, Tex.
PREDICTION OF EYE SAFE SEPARATION DISTANCES
Everett O. Richey *In* AGARD Loss of Vision from High Intensity Light 1966 p 203–224 refs (See N67-29341 16-04)

A method, for predicting the distances at which the thermal radiation from nuclear detonations will be hazardous to the unprotected human eye, relates calculated retinal exposure to experimentally determined eye effects data. Graphs are used to show experimental laboratory data on animals relating minimal retinal burns and flash blindness duration to retinal exposures. Eye hazards as a function of distance are determined for the unprotected human eye exposed to sea level, air-burst detonations from 0.01 to 1,000 kT yield. The pupil diameter of the human eye is taken to be 2.5 mm and 6.0 mm, respectively, for day and night conditions; and the effective focal length of the eye is taken to be 17 mm. Eye hazards as a function of distance are also determined for the human eye protected from daytime detonations by a 2% transmission fixed filter. Results indicate that such a filter provides eye protection at distances where other hazards become limiting factors. Author

N67-29354# Advisory Group for Aeronautical Research and Development, Paris (France).
RESISTANCE TO FLASH BLINDNESS AND AIRCREW SELECTION
A. Mercier and G. Perdriel *In its* Loss of Vision from High Intensity Light 1966 p 225–234 (See N67-29341 16-04)

Comberg's recording nyctometer was used to investigate the resistance of aircrew to dazzle. It was shown that the time lag for return to a useful visual acuity (5/10) after exposure to a flash does not change with the subject's age; and that normal recuperation takes place in 60% of the subjects, excellent recuperation in 30%, and insufficient recuperation in 10% of the cases. This poor dazzle resistance is characterized by a time lapse of 60 sec before reaching an acuity of 1/10, and an inability to reach more than 3/10 in 120 sec. It would, therefore, appear useful to introduce a test for visual recuperation time after dazzle into the aircrew selection physical examination. Preliminary results are included for 14 subjects tested for dazzle resistance before and after having taken five anthocyanoside tablets per day for five days. Five subjects showed a reduction in visual acuity, with prolongation of response time by 1 to 2 sec; 12 subjects demonstrated improved dazzle resistance with recovery time reduced 1 to 2 sec; and 14 subjects showed no change. M.W.R.

N67-29388*# Dunlap and Associates, Inc., Darien, Conn.
PERIPHERAL VISION DISPLAYS
Leroy L. Vallerie Washington, NASA, Jun. 1967 106 p refs (Contract NAS12-88)
(NASA-CR-808) CFSTI: $3.00 CSCL 06B

Effectiveness of peripheral vision displays for presenting dynamic tracking information during difficult control tasks such as landing high-speed aircraft or rendezvousing spacecraft was studied. Based on a review of the literature, it was hypothesized that peripheral displays could be successfully used to improve performance provided visual switching between information sources is normally an essential part of such tasks. Visual switching consists of eye movement, accommodation, and convergence. The hypothesis was tested in the laboratory by comparing operator performance on a two-dimensional compensatory tracking task under conditions in which the requirements for visual switching and the provisions of peripheral displays were systematically varied and controlled. It was clearly demonstrated that tracking performance deteriorates as visual switching increases, and that peripheral displays can be used to overcome its adverse effects. Author

N67-29388*# Johns Hopkins Univ., Baltimore, Md.
STUDY OF EXTRAVEHICULAR PROTECTION AND OPERATIONS
P. Iribe and J. A. Lieske Washington, NASA, Jun. 1967 129 p refs
(Grant R-21-009-007; Contract NOw-62-0804-c)
(NASA-CR-773) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A study is made of the requirements placed on extravehicular protection and operation devices by the orbital environment and contemplated oribital missions. The orbital missions studied cover the period 1970–1978 to the extent that they are presently defined. The conclusions favor a suited astronaut supported by propulsion, communication, and working aids (non-anthropomorphic suits were not included in this study). Concepts of vehicles satisfying the requirements developed are presented as is the concept of a modularly assembled device which can be modified to best suit specific mission requirements. Author

N67-29398*# Webb Associates, Yellow Springs, Ohio.
HUMAN WATER EXCHANGE IN SPACE SUITS AND CAPSULES
Paul Webb Washington, NASA, Jun. 1967 76 p
(Contract NASr-115)
(NASA-CR-804) CFSTI: HC $3.00/MF $0.65 CSCL 06S

This paper reviews the exchanges of water in normal man and considers the control of body water content. The following subjects are presented in some detail: insensible water loss from the skin and to the expired air; non-thermal, or psychogenic sweating; thermal sweating as influenced by metabolic level, environment, and other factors. The unexpected finding of weight loss in all manned flights, which is some 2–5% of body weight and is not affected by flight duration, may be a response to weightlessness causing a readjustment of body water. Medical problems considered are heat storage and heat exhaustion, dehydration and skin hygiene. Operational problems discussed include water supply, mild dehydration and environmental stress indices. Research is needed to clarify the mechanism of the weight loss of space flight and its effect on performance. A method of determining body mass should be developed. A specific thermal stress index is needed for space suit and space cabin use. We need better definitions of water requirements, and better definitions of the effects of mild dehydration. Author

N67-29420# Naval School of Aviation Medicine, Pensacola, Fla.
PREDICTING SUCCESS IN NAVAL FLIGHT OFFICER TRAINING
Floyd E. Peterson, Richard F. Booth, Norman E. Lane, and Rosalie K. Ambler 15 Feb. 1967 15 p ref
(NAMI-996; AD-650364) CFSTI: HC $3.00/MF $0.65

The purpose of this study was to develop a system for the prediction of success or failure in the Naval Flight Office (NFO) program for use during basic NFO training. Two initial selection tests (an academic ability test and a mechanical comprehension test) plus two academic performance measures resulted in a multiple correlation coefficient of .45 with a dichotomous criterion of

pass/attrite. Decision making regarding the retention of marginal students could be improved by use of the prediction formula generated in this study. Author (TAB)

N67-29488# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE USE OF UNIVERSAL ELECTRONIC COMPUTERS FOR PROGRAMMED INSTRUCTION [OB ISPOL'ZOVANII UNIVERSAL'NYKH ELEKTRONNOVYCHISLITEL'NYKH MASIN DLYA PROGRAMMIROVANNOGO OBUCHENIYA]
V. G. Koryakov 17 Mar. 1967 26 p refs Transl. into ENGLISH from Programmirovannoye Obucheniye i Kiberneticheskiye Obuchayushchiye Machiny (USSR), 1963 p 139–159
(FTD-MT-65-202; TT-67-61650; AD-651035) CFSTI: HC $3.00/MF $0.65

A discussion is given of certain results of experimental application of digital computers to programmed learning and the principles of constructing teaching systems. Three models of the teaching process are presented: parallel, sequential, and branching. A block diagram is given for a training system using an electronic computer, and use of the 'Ural 1' machine with ST-35 instruments as inputs is discussed for teaching translation from German to Russian and design of radio receivers. Use of multipurpose computers (UMShN/Universalnaya Mashina Shirokogo Naznacheniya/) with automatic film viewers as output devices for study of radiotechnical circuits is described. TAB

N67-29491# Sylvania Electric Products, Inc., Waltham, Mass.
AN INVESTIGATION OF HUMAN PROCESSING OF INFORMATION IN WEATHER FORECASTING Final Report, 15 May 1965–14 Nov. 1966
Donald B. Devoe Bedford, Mass., AFSC, Electron. Systems Div., 31 Jan. 1967 152 p refs
(Contract AF 19(628)-5176)
(ESD-TR-67-218; F-5151-1; AD-650918) CFSTI: HC $3.00/MF $0.65

As an approach to the analysis of human functions in complex systems, techniques were devised and tested for analyzing information processing by weather forecasters. The field interview as a source of information on the utilization of centrally-prepared aids to forecasting was evaluated at two Air Force weather stations. The presentation of weather information via a forecaster's console was simulated in the laboratory and tested experimentally both as a means for analyzing information processing by forecasters and as a test bed for evaluating new approaches to the display of weather information. The results of the interviews and the experiment are discussed regarding their implications for weather forecasting and for research methodology, and further studies are recommended. TAB

N67-29493# School of Aerospace Medicine, Brooks AFB, Tex.
BIO-TELEMETRY PROBLEMS DURING PROLONGED SPACE MISSIONS [PROBLEMY BIOTELEMETRII V DLITEL'NYKH KOSMICHASKIKH POLETAKH]
I. T. Akulinichev, A. M. Zhdanov and I. I. Popov [1967] 14 p Transl. into ENGLISH of Russian Paper Presented at Intern Astronaut. Cong., Madrid, 9–15 Oct. 1966
(SAM-TT-R-814-1166; TT-67-61273; AD-648490) CFSTI: HC $3.00/MF $0.65

In the future, spacecraft will undergo structural changes (welding processes and partitioning or distribution of weight and equipment), and the crewmembers will perform more and more extravehicular activities; therefore, the medical control systems will also have to be changed accordingly. Radio communication channels and instruments will also have to conform with the different operational tasks. At present, short-range (on-board and near spacecraft) bio-telemetry systems present a relatively large number of problems. In fact, those involving important technical and experimental construction principles and some of the basic parameters have not been solved as yet. The report discusses the need for future theoretical and experimental research of radio waves propagation in solid, closed spaces and for the implementation of radio channels offering a highly reliable transmission of bio-telemetry data. Author (TAB)

N67-29549# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROGRAM FOR DELINEATION OF TRACE CONSTITUENTS OF A CLOSED ECOLOGIC SYSTEM Final Report, 2–29 Jun. 1965
R. W. Rinehart, M. Honma, W. N. Tuttle, R. E. Nygren, O. L. Flowers et al Brooks AFB, Tex., USAF School of Aerospace Med., Jan. 1967 22 p Submitted for publication
(Contract AF 41(609)-2788)
(SAM-TR-67-4; AD-650003) CFSTI: HC $3.00/MF $0.65

The report contains analytical data on 81 samples of gas (27 sets) collected from a simulated space cabin. Each set is comprised of a sample collected cryogenically at 0, -78, and -175C. Analytical procedures are given for the gas chromatography, infrared spectrophotometry, and mass spectrometry utilized in the performance of this project. Possible errors involved in low-level contaminant collection and analysis are included. Author (TAB)

N67-29582*# Air Force Cambridge Research Labs., Bedford, Mass.
RESPONSE TIMES IN DECISION-MAKING TASKS
Everett F. Dagle, Margaret D. Hill, and William R. Smith (Xerox Corp., Rochester, N. Y.) Dec. 1966 14 p *its* Phys. Sci. Res. Papers no. 300
(AFCRL-66-633; AD-650908) CFSTI: HC $3.00/MF $0.65

The extent to which the output in semiautomated systems that utilize human operators is quantitatively and qualitatively accurate is an obvious function of system performance. When assigned to a logical function in a system, the human operator quite often affects total performance; however, little is known about his sources of error, particularly when his response time is concerned. The study presents experimental evidence which supports the hypotheses that human operators differ widely in the time they require to make decisions and it also provides data that show the degree of consistency or reliability of time measures taken at different times. By using data gathered in the manner outlined in this study, human operators could be matched to command or control systems according to the degree of speed and accuracy required by the particular system. Greater overall efficiency and a maximum output for any given system would be the result. TAB

N67-29565# Joint Publications Research Service, Washington, D. C.
RECENT DEVELOPMENTS IN CYBERNETICS—USSR
29 Mar. 1967 17 p Transl. into ENGLISH from Znannya ta Pratsa (Kiev), no. 11, 1966 p 4–5; 14–16
(JPRS-40456; TT-67-31101) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. SPEECH RECOGNITION MACHINE DEVELOPED BY TWO KIEV SCIENTISTS S. Andriyev'skyy p 1–5 (See N67-29566 16-05)

2. APPLICATIONS OF CYBERNETIC MODELING IN MEDICINE AND SOCIOLOGY V. Galuzns'ka p 6–12 (See N67-29567 16-04)

N67-29566# Joint Publications Research Service, Washington, D. C.
SPEECH RECOGNITION MACHINE DEVELOPED BY TWO KIEV SCIENTISTS
S. Andriyev'skyy *In its* Recent Develop. in Cybernetics—USSR 29 Mar. 1967 p 1–5 (See N67-29565 16-05)

A speech recognition device is described that can, in conjunction with a computer, recognize 20 words, permitting the reception of several hundred verbal commands. It is pointed out that differences in human voices do not affect the performance of the machine. The machine was first instructed to recognize the digits from one to nine and then several verbal commands, e.g., stop and start. In order to give the verbal signals a digital form, a spectral analysis of signals was undertaken with the aid of a system of band filters. The sound vibrations were converted to electrical oscillations and then screened through special filters. The distinguishing features of the signal are then stored in the machine's memory in the form of a set of digits. L.E.W.

N67-29696# Service Bureau Corp., New York.
NEUROMIME NETWORK SIMULATOR. APPENDIX II: NEUROMIME SIMULATOR OUTPUT Final Report, 19 Mar. 1963–15 Apr. 1966
James Flaugher Wright-Patterson AFB, Ohio, AMRL, Sep. 1966 378 p
(Contract AF 33(657)-11194)
(AMRL-TR-66-101, Vol. II; AD-650567) CFSTI: HC $3.00/MF $0.65

Because of the large number of network combinations and parameter variations possible in a Steele neuromime network, a program for simulating the nets on a digital computer is being developed to aid in determining the most efficient nets for specific tasks. The results of the investigation of network and parameter variations may then be used as the restraints and design criteria for neuromime devices with specific signal recognition capabilities. The simulation provides as a tool, a means of generating randomly connected networks with desired statistical restraints and a training phase which alters the network in such a manner as to force the actual response closer to the desired response. The generalized nature of the nets used is the essence of the research effort. Appendix II contains the neuromime simulator output. Author (TAB)

N67-29630# George Washington Univ., Alexandria, Va. Human Resources Research Office.
AIRCRAFT DETECTION, RANGE ESTIMATION, AND AUDITORY TRACKING TESTS IN A DESERT ENVIRONMENT
Edward W. Frederickson, Joseph F. Folletie, and Robert D. Baldwin Mar. 1967 49 p refs
(Contract DA-44-188-ARO-2)
(TR-67-3; AD-650403) CFSTI: HC $3.00/MF $0.65

Detection tests with low-flying jet aircraft were conducted to determine the effect of (a) varying the location of observers from the flight path, (b) using optical aids vs. unaided observation, and (c) varying the amount of temporal early warning. Also tested were man's ability to (a) visually estimate the distance to high-speed jets, (b) track aircraft by ear, and (c) determine the distances at which various aircraft structural features were recognized. When distant terrain masking existed, unaided and optically aided detections occurred at approximately the same time. However, when near terrain masking existed, unaided detections occurred sooner. Using binoculars resulted in earlier recognition of structural features. A change from one minute to five minutes of temporal early warning did not affect detection range. As offset increased from 200 meters to 3,300 meters, detection range increased. The range estimation tests were inconclusive. The results of the auditory tracking tests suggest that it may be possible to extend the capabilities of some fair weather air defense systems to poor visibility conditions. The order in which structural features were recognized was different between fighters and bombers, but there were consistencies within each class of aircraft. Author (TAB)

N67-29695*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
TEMPERATURE CONTROL OF THE ORBITAL OTOLITH EXPERIMENT
Paul R. Schrantz Washington, NASA, Jun. 1967 73 p refs Sponsored in Part by NASA
(Contract NOw-62-0604-c)
(NASA-CR-815; TG-815) CFSTI: $3.00 CSCL 06K

This report presents a description of the temperature control system that has been developed for the Orbital Otolith Experiment. The experiment has been packaged in a cylindrical vessel which will be installed in one of the first manned Apollo vehicles. A water supply in which two frogs are submerged must be maintained at 65 plus or minus 5 F for approximately 1000 hours in orbit. The thermal design approach has been to thermally isolate the capsule from the Service Module. The total heat load may reach 20 watts including a continuous internal load of 12 watts. An evaporative cooling system has been developed for use during the time that the water temperature exceeds a thermostat setting of 65 F. Passive thermal control is employed during conditions of low ambient temperatures as well as during the prelaunch phase, when the evaporative cooler is inoperative. The program has reached the completion of the Engineering Model phase. This report includes a summary of the thermal vacuum test program which was carried out to verify the adequacy of the temperature control system. The results have been implemented in the design of the flight prototype and flight models to be supplied to NASA in 1966. Author (TAB)

N67-30011 SAAB Aircraft Co., Linkoping (Sweden).
INTERPRETABILITY STUDIES OF ELECTRONIC FLIGHT INSTRUMENTS
Bengt Bergstrom Jan. 1967 38 p refs
(SAAB-TN-61) CFSTI: $3.00

Different configurations of an electronic head-down display were compared experimentally with regard to interpretability, using tachistoscope techniques. Interpretability was defined in terms of the method of measurement. Out of four scalings of pitch angle, the results clearly favoured a linear and a slightly "broken" scale. Two, more extremely "non-linearized" scales had lower interpretability. Assessment of pitch angle was more precise when the display contained an aircraft symbol that when it did not. In comparing two different indications of up in the display, a configuration with vertical lines standing on the horizon proved to be more interpretable. Results will be of assistance in choosing between alternative design proposals for a head-down display. Author

N67-30022*# Serendipity Associates, Los Altos, Calif.
A FULL MISSION SIMULATION SCENARIO IN SUPPORT OF SST CREW FACTORS RESEARCH Final Report
Walter B. Gartner, William J. Erenata, and Vincent R. Donohue Jan. 1967 174 p refs
(Contract NAS2-3589)
(NASA-CR-73096; TR-67-41-2(U)) CSCL 05H

Reported is a study designed to support the development and utilization of a full mission supersonic transport simulation facility by providing materials which will enable research personnel to generate more realistic representations of flight crew workload and operational task conditions in crew factor simulation research projects. Data are organized into three sections. In Part I, the key concepts underlying the development of the simulation scenario are presented. The central concept of crew task demands (CTDs) as simulation referents is introduced and the usefulness of this concept in deriving simulation requirements is elucidated. The concept of functional equivalence is also elaborated as an essential part of the conceptual base established to facilitate scenario development. The simulation scenario, which is a compilation of CTDs occurring throughout a generalized SST flight profile, is presented in Part II. Part III was designed to assist the scenario user in the subsequent derivation of design requirements and utilization plans for the SST simulator. Implications of the simulation requirements expressed in Part II are considered in terms of the essential design features of

CDT presentation media which may be selected or designed for use in the simulator. Summary simulation design and/or utilization requirements are provided which identify the presentation media considered appropriate for representing specified subsets of CTDs. It is surmised that the summary requirement statements presented in Part III should thus enable scenario users to determine the CTD presentation materials and techniques needed to implement a given simulation sequence. S.C.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-29007*# International Information, Inc., Philadelphia, Pa.
X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF YTTRIUM BY SOLUTION METHOD
E. Asada and S. Matsuda Washington, NASA, Jun. 1967 13 p refs Transl. into ENGLISH from Bunseki Kagaku (Tokyo), v. 15, 1966 p 1104–1109
(Contract NASw-1499)
(NASA-TT-F-10975) CSCL 07D

From the study of absorption effect by the solution method, using nitric acid, it was found that a linear relationship always exists between the reciprocal of the fluorescent X-ray intensity of yttrium and the reciprocal of yttrium concentration. It was demonstrated that intersection on the Y-axis always represented a constant value. A new analytic technique, based on these observations, has led to the achievement of rapid and accurate assaying of the yttrium content in rare earth compounds. Author

N67-29014*# Holman (John F.) and Co., Inc., Washington, D. C.
INVESTIGATION OF THE CHANGES OF THE ROTATION–VIBRATION SPECTRUM OF CERTAIN SIMPLE MOLECULES DURING DISSOLUTION [ISSLEDOVANIYE IZMENENIY VRASHCHATEL'NOKOLEBATEL'NOGO SPEKTRA NEKOTORYKH PROSTYKH MOLEKUL PRI RASTVORENII]
M. O. Bulanin and N. D. Orlova Washington, NASA, Jun. 1967 10 p refs Transl. into ENGLISH from Opt. i Spektroskopia (Moscow), v. 4, no. 5, 1958 p 569–574
(Contract NASw-1495)
(NASA-TT-F-11027) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Additional absorption bands unassociated with the intramolecular degrees of freedom have been detected in the infrared spectra of the solutions of hydrogen halides in water. By comparing the spectra of solutions with the spectra of gases the additional bands were interpreted as the diffuse groups of rotational branches. This indicates that the almost free rotation of dissolved substance molecules is retained in solutions. As the interaction with the solvent increases rotation changes to libration. Author

N67-29015*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATIONS INTO ATTACHMENT PROPERTIES OF RADIOACTIVE AEROSOLS [UNTERSUCHUNGEN UEBER ANLAGERUNGSVORGAENGE RADIOAKTIVER AEROSOLE]
V. Mohnen Jun. 1967 32 p refs Transl. into ENGLISH of Munich Univ., 1st Physical Inst. Rept.-BMWF-FBK-66-11, May 1966
(NASA-TT-F-11031; BMWF-FBK-66-11) CSCL 07E

The attachment of ions and radioactive emanation products to aerosols is studied. Based on the exact solution of the diffusion equation, all possible parameters used in this equation are discussed and all possible steps for simplifying the resultant equation are theoretically examined for deviations from the exact value. A strict differentiation is made between attachment of neutral and electrically charged radioactive decay products. The time for ion and for neutral decay product capture by a given aerosol mixture is calculated, and a method is theoretically substantiated for determining the total number of particles and their size spectrum (using a cylindrical condenser as particle discriminator). Author

N67-29018*# International Information, Inc., Philadelphia, Pa.
NITROGEN SOLUBILITY IN LIQUID AND SOLID CHROMIUM AT ELEVATED GAS PHASE PRESSURE [RASTVORIMOST' AZOTA V ZHIDKOM I TVERNOM KHROME PRI POVYSHENNOM DAVLENII GAZOVOY FAZY]
V. M. Berezhiani and B. M. Mirianashvili Washington, NASA, Jun. 1967 5 p refs Transl. into ENGLISH from Tr. Gruzinsk. Inst. Met. (USSR), v. 14, 1964 p 163–166
(Contract NASw-1499)
(NASA-TT-F-11053) CSCL 07B

A series of tests was performed to determine the rate of nitrogen dissolution in solid and liquid chromium at different temperatures and pressures. Nitrogen was found to dissolve in chromium in its elemental form and to form a chemical compounds. The concentration of dissolved nitrogen was found to increase with both temperature and pressure. Author

N67-29043# Army Engineer Research and Development Labs., Fort Belvoir, Va.
THE KINETICS OF THE THERMAL DECOMPOSITION OF MOLTEN SILVER AZIDE
Herbert J. Mueller Mar. 1967 20 p refs
(AERL-1893; AD-651062) CFSTI: HC $3.00/MF $0.65

The report covers an investigation of the thermolysis of molten silver azide (AgN3), which process is considered to be fundamental for the ignition of the explosive by thermal stimulus. The isothermal decomposition of molten silver azide was investigated in the temperature interval 309-340C. Decomposition was found to occur at the metal-azide interface with an activation energy of 38 plus or minus 2.5 kcal/mole. Initially, the decomposition proceeds at a constant rate. After a while, the reaction becomes accelerated as a result of the formation of silver nuclei in the melt. The rate of reaction is then proportional to the third power of time, and an apparent energy of activation of 138 plus or minus 5 kcal/mole is measured. The activation energy for the growth of silver nuclei in the melt is estimated to be ca. 24 kcal/mole. The latter value can be interpreted as the activation energy for the migration of interstitial silver in the azide matrix. Author (TAB)

N67-29078# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
IDENTIFICATION OF AEROSOL PROPELLANTS IN PAINT PRODUCTS BY GAS-LIQUID CHROMATOGRAPHY Final Report
George G. Esposito Mar. 1967 13 p refs
(CCL-226; AD-650642) CFSTI: HC $3.00/MF $0.65

Aerosol packaged paint products have gained widespread acceptance in recent years. Because of safety and toxicity factors, the type of propellant employed is of vital importance. The report describes a rapid, specific procedure for the identification of propellants using gas-liquid chromatography. A chilled can of paint is sprayed into a test tube and the atmosphere above the liquid is sampled. The analysis is conducted on silicone grease and porous polymer columns. Author (TAB)

N67-29083# Calvin Coll., Grand Rapids, Mich. Dept. of Chemistry.
SILVER OXIDE ELECTRODE PROCESSES
Thedford P. Dirkse 1 Mar. 1967 24 p refs
(Contract Nonr-1682(02))
(TR-6; AD-650152) CFSTI: HC $3.00/MF $0.65

The cathodic and anodic overvoltages at a silver electrode were measured in a range of KOH concentrations of 20 to 45%. The values of these overvoltages undergo a change in 30 - 35% KOH. Similar changes or maxima or minima have been observed for other phenomena in KOH solutions, e.g., double layer capacitance. An attempt to account for these changes is made in terms of ion-pair association in concentrations greater than 35% KOH. This association is due to insufficient solvent for the normal hydration of the ions. Author (TAB)

N67-29120# Virginia Inst. for Scientific Research, Richmond.
MOSSBAUER EFFECT STUDIES OF SURFACE REACTIONS Final Report, 1 Dec. 1966–30 Nov. 1966
Melvin C. Hobson, Jr. Apr. 1967 14 p refs
(Grant AF-AFOSR-1049-66)
(AFOSR-67-0923; AD-651129) CFSTI: HC $3.00/MF $0.65

A constant-acceleration type Mossbauer spectrometer was constructed and employed in studies concerning the chemical reactivity of surface atoms. Particular attention was given to Mossbauer effect studies of the hydrogen-reduction of supported iron catalysts. Initial results indicate the probable state of the reduced iron is a mixed ferrous-ferric oxide in the form of very small particles on the surface of the silica gel support. TAB

N67-29228# Melpar, Inc., Falls Church, Va.
A STUDY OF RANDOM NETWORK MODELS
Fred Ordway 7 Apr. 1967 82 p refs
(Contract N00014-66-C-0258)
(Rept.-6353.00100; TR-1; AD-650754) CFSTI: HC $3.00/MF $0.65

A fully bonded tetrahedral network model was built, by a procedure approximately simulating condensation from vapor, up to a total of 300 units. From the topological data and measured coordinates of the centers and vertices, the ring size distribution, average density, and radial distribution functions were calculated. Although this model contained a large regular nucleus, and therefore does not fully represent the random network theory, the close similarity of its radial distribution with that of vitreous silica indicates that such networks can represent real amorphous structures quite accurately. Matching the densities of liquid water and vitreous silica may require imperfections in bonding of the network. The topological and geometrical data, which define the structure completely, are reproduced in full. Author (TAB)

N67-29230# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
SUPPLEMENTARY DIELECTRIC-CONSTANT AND LOSS MEASUREMENTS ON HIGH-TEMPERATURE MATERIALS
J. Iglesias and W. B. Westphal Jan. 1967 124 p refs
(Contracts Nonr-1841(10); AF 33(615)-2199)
(TR-203; AD-650230) CFSTI: HC $3.00/MF $0.65

A summary report is given on dielectric constant and loss measurements made in the laboratory for insulation research after 1958, excepting high-dielectric-constant materials. The emphasis is on high-temperature materials (those with melting points above 1200C), but data on some plastics and liquids are also included. The samples of solids include oxides of Al, Be, Cr, Hf, Mg, Si, Ta, Th, Y, Zr, nitrides of B and Si, LaAlO3 and various silicates, rocks, and minerals. Pure samples of Al2O3, BeO, MgO, SiO2, and BN all show loss tangents < 0.01 at 1500C in the microwave region. Various phenomena of electric loss, e.g., transconductance, dipole orientation, and molecular vibrations are clearly discernible. Author (TAB)

N67-29231# Olin Mathieson Chemical Corp., New York. Chemicals Group.
DEVELOPMENT OF SOLVENT-RESISTANT SEALANTS Final Report, 1 Feb. 1966–31 Jan. 1967
M. M. Boudakian, M. C. Raes, and S. V. Urs 15 Feb. 1967 48 p refs
(Contract NOw-66-0323-d)
(AD-650315) CFSTI: HC $3.00/MF $0.65

Urethane type sealants compounded from CF3 and C7F15-containing polyether triols, toluene diisocyanate and moisture cured were developed with good resistance to paint-stripper solvents, high mechanical properties and excellent adhesion to aluminum substrate. A number of fluorine-containing mono- and diglycidyl ethers, perfluorinated epoxides and fluorine-rich diamines and polyols were synthesized for compounding into urethane- and epoxy-type sealants. It is recommended to carry out a detailed evaluation of the compounds to select a candidate for field trial. Author (TAB)

N67-29262# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie.
SOLID CHEMICAL INVESTIGATIONS OF THE SYSTEMS $SeO_{1.5}$–$ZrO_2(HfO_2)$, $AmO_{1.5}$–$ZrO_2(HfO_2, ThO_2)$–O_2, AND TiO_2–$NpO_2(PuO_2)$ [FESTKOERPERCHEMISCHE UNTERSUCHUNGEN UEBER DIE SYSTEME $SeO_{1.5}$–$ZrO_2(HfO_2)$, $AmO_{1.5}$–$ZrO_2(HfO_2, ThO_2)$–O_2 UND TiO_2–$NpO_2(PuO_2)$]
Hubert Radzewitz Jul. 1966 53 p refs in GERMAN
(KFK-433)

The pyrochlore type and the fluorite phases with 1:1 composition of the rare earth oxides with Zr and Hf oxides were prepared and the dependence of the homogeneity range of the pyrochlore phase on the composition and the reaction temperature was investigated. In the system $NdO_{1.5}$–ZrO_2(1300°C) the homogeneous cubic phase of the fluorite and pyrochlore type was obtained at 27 to 57 mol % $NdO_{1.5}$. The range of the homogeneous cubic phase of the fluorite and pyrochlore type extended in the $EuO_{1.5}$–ZrO_2(1300°C) from 18 to 71 mol % $EuO_{1.5}$. In the system $HoO_{1.5}$–ZrO_2(1300°C) a homogeneous phase of the fluorite type was detected in the range from 8 to 72 mol % $HoO_{1.5}$. In the system $AmO_{1.5}$–ZrO_2 a cubic phase was observed at 1200°C from 35 to 55 mol % $AmO_{1.5}$. The homogeneous cubic phase of the pyrochlore type was reached in the $NbO_{1.5}$–HfO_2 (1500°C) at 45 to 55 mol % $NbO_{1.5}$. In the system $EuO_{1.5}$–HfO_2(1500°C) a homogeneous cubic phase was established from 20 to 72 mol % $EuO_{1.5}$. This phase consisted of the fluorite and pyrochlore type. On the other hand in the system $HoO_{1.5}$–HfO_2(1500°C) from 15 to 71 mol % $HoO_{1.5}$ only the fluorite phase was observed. In the system $AmO_{1.5}$–HfO_2(1400°C) the range of the homogeneous cubic phase lay between 45 and 55 mol % $AmO_{1.5}$. At 1,480°C ThO_2 took a maximum of 48 mol % $LaO_{1.5}$. The upper solubility limit for $NbO_{1.5}$(1500°C) and $AmO_{1.5}$(1300°C) was determined as 50 mol %. O_2 vacancies occurred in these systems. In the system AmO_2–ZrO_2(1200 and 1400°C) there was a continuous miscibility of both oxides over 17 mol % AmO_2. In the system AmO_2–ThO_2 it was established that AmO_2 and ThO_2 mixed continuously with each other with linear changes of the lattice constants. In the system ThO_2–TiO_2 the formation of $ThTi_2O_6$ with two allotropic modifications was confirmed at 1000 and 1400°C. The high-temperature form β-$ThTi_2O_6$ was identified as monoclinic. In the analogous system NpO_2–TiO_2 the isotope compound $NpTi_2O_6$ was prepared and it had a monoclinic structure. A corresponding Pu compound could not be obtained. Author (NSA)

N67-29267# Case Inst. of Tech., Cleveland, Ohio. Dept. of Chemistry.
PRIMARY PROCESSES IN RADIATION CHEMISTRY Progress Report, 15 Feb. 1966–30 Jan. 1967
Edwin W. Abrahamson [1966] 92 p refs
(Contract AT(11-1)-904)
(TID-23710) CFSTI: HC $3.00/MF $0.65

Developments are reported for theoretical studies on: the spectroscopic basis of carbonyl photochemistry; an iterative

extended Hueckel molecular orbital calculation on acetone; ab initio and iterative extended Hueckel molecular orbital calculations on planar and nonplanar states of formaldehyde; spectroscopic basis of ethylene photochemistry; mechanism of transfer of triplet excitation energy in complex molecules; experimental studies on: flash photolysis of kinetics of luminescence decay of excited iodine atoms in the presence of quenching agents and flash photolysis of diazines. Reprints are included for two papers, and manuscripts are included for papers on: photodecomposition and luminescent states of acetone; spectroscopic basis of ethylene photochemistry; mechanism of the collisional transfer of triplet excitation energy; and time resolved emission of electronically excited iodine atoms I ($S^2P_{1/2}$). NSA

N67-29275# Los Alamos Scientific Lab., N. Mex.
DIFFUSION OF URANIUM IN GRAPHITE
M. Hrovat and G. Spenar [1966] 9 p Transl. into ENGLISH from J. Nucl. Mater. (Amsterdam), v. 19, 1966 p 53–58
(LA-TR-66-61) CFSTI: HC $3.00/MF $0.65

Measurements of the diffusion of uranium out of uranium carbide pellets in porous graphite at 1400–2000°C surprisingly revealed a strong dependence of the rate on previous treatment of the uranium carbide. Experiments with a 0.5 mm slit between the carbide and graphite proved that uranium is transferred via the gas phase. The results indicate that transport is considerably affected by traces of a uranium–oxygen compound present on the uranium carbide surface. Author (NSA)

N67-29279# Oak Ridge National Lab., Tenn.
THE METABOLISM OF TRANSURANIUM ELEMENTS
Jean-M. Debois [1966] 14 p Transl. into ENGLISH from Assoc. Belge Develop. Pacifique Energie At. Bull. Inform. (Brussels), v. 11, no. 60, 1966 p 13–17
(ORNL-TR-1463)

The toxicity and metabolism of the transuranium elements are reviewed. Special aspects of the metabolism of ^{237}Np, Pu, ^{241}Am, Cm, and ^{252}Cf are discussed. The resorption and inhalation of Pu are considered in some detail. NSA

N67-29321# Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu.
EXTRACTION OF ALKALI–EARTH METALS BY ORGANIC SOLVENTS
M. Pivonkova and M. Kyrs Nov. 1966 22 p refs
(UJV-1573) CFSTI: HC $3.00/MF $0.65

A summary of literature data on the extraction of alkaline earth metals by means of organic solvents is presented. Extractions using organophosphoric compounds, oxines, thenoyltrifluoroacetone (TTA), other non-selective agents, selective agents for calcium and strontium, and strong polar solvents are discussed. NSA

N67-29322# Oak Ridge National Lab., Tenn.
ENRICHMENT OF C-12 AND C-13 BY GAS-PHASE CHROMATOGRAPHY OF CO ON MOLECULAR SIEVES
C. Blanc Jan. 1966 54 p refs Translated into ENGLISH of Rept. No. 59, Soc. Natl. de Petrol. d'Aquitaine
(ORNL-TR-1435) CFSTI: HC $3.00/MF $0.65

An original method is described for enrichment of ^{12}C and ^{13}C by gas chromatography of CO on a molecular sieve. A model for the separation is given. Enrichments of from 1 to 9% were obtained when the temperature was decreased from 100° to −30°C. Besides the temperature, the column length strongly affected the enrichment factor. A systematic study of the different parameters entering into chromatography made it possible to optimize the enrichment and obtain an enrichment of 30%. NSA

N67-29324# Oak Ridge National Lab., Tenn.
CHARACTERIZATION OF RADIOACTIVE PARTICULATE AEROSOLS BY THE FIBROUS FILTER ANALYZER
M. D. Silverman, J. Truitt, W. E. Browning, Jr., and F. L. Franzen Mar. 1967 64 p refs
(Contract W-7405-ENG-26)
(ORNL-4047) CFSTI: HC $3.00/MF $0.65

The fibrous filter analyzer (FFA) has been developed for measuring the characteristics of radioactive aerosols in terms of their response to filtration processes by determining their distribution vs depth in a filter under carefully controlled conditions. Moisture did not significantly affect the performance of the FFA, although the test aerosol itself was affected. The filtration efficiency data agreed well with the theoretical treatment of filtration developed by Torgeson. The analyzer was calibrated against particles of 150 to 1500 Angstroms in diameter, measured by electron microscopy. Author (NSA)

N67-29325# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
HIGHLY-LOCALIZED BRIGHT TRACKS IN HELIUM-FILLED STREAMER CHAMBER [POLUCHENIE KHOROSHO LOKALIZOVANNYKH SLEDOV VYSOKOI YARKOSTI V STRIMERNOI KAMERE S GELIEM]
M. M. Kulyukin, D. B. Pontekorvo, I. V. Falomkin, and Yu. A. Shcherbakov 1967 20 p refs In RUSSIAN; ENGLISH summary
(JINR-P13-3123)

It is shown that by making use of admixtures of complicated hydrocarbons it is possible to obtain bright localized particle tracks in a streamer chamber with helium without preliminary shaping of the high-voltage pulse. NSA

N67-29327# Iowa State Univ. of Science and Technology, Ames.
ELECTROTRANSPORT OF OXYGEN, NITROGEN AND CARBON IN VANADIUM
Jairus Charles Warner (M.S. Thesis) Nov. 1966 80 p refs
(Contract W-7405-ENG-82)
(IS-T-133) CFSTI: HC $3.00/MF $0.65

The electrotransport of O_2, N_2, and C in V was studied at 1825° to 1650°C. The samples were in the form of two-fold semi-infinite rods, like diffusion couples, so that under certain conditions the end effects could be neglected. It was found that migration of all the interstitial contaminants is toward the electrically negative pole. Diffusion coefficients were also determined. It was shown that within experimental error the electric mobility is not a function of the electric field but only of temperature. The specific resistivity was determined and a plot of the resistivity function is presented. The published literature on electrotransport of interstitial elements in metals is reviewed. Three hypotheses are made regarding the direction of interstitial migration. Author (NSA)

N67-29330# Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu.
RADIATION CHEMICAL OXIDATION OF CYCLOHEXANE AND SOME RELATED HYDROCARBONS [RADIATSIONNOE OKISLENIE TSIKLOGEKSANA I NEKOTORYKH RODSTVENNYKH UGLEVODORODOV]
I. Sistek Dec. 1966 14 p refs In RUSSIAN; ENGLISH summary
(UJV-1703)

Radiochemical oxidation of cyclohexane was studied, and yields were determined analytically. A mixture of cis- and trans-decaline (1:3) was studied. The effects of side-chain and double bonds on the consumption of O_2 and on the yields of hydrocarbon peroxides, which appear to be derivatives of cyclohexane, were also studied. The material balance of gaseous products was unsatisfactory when only hydrogen and oxygen were considered. Author (NSA)

N67-29335# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.

EXPERIMENTS ON CHEMICAL PROPERTIES OF ELEMENT 102. I: ABSORPTION OF A CHLORIDE OF ELEMENT 102 FROM THE GASEOUS PHASE

Yu. T. Chuburkov, R. Tsaletka, M. R. Shalaevskii, and I. Zvara 1967 14 p refs

(JINR-E6-3076) CFSTI: HC $3.00/MF $0.65

Studies were made of the chemical properties of element 102. The volatility of the chloride of this element was similar to the volatilities of chlorides of Th, Cf, and Fm. There was a high degree of separation of element 104 from spontaneously fissioning $^{258}102$ in the experiments on chemical identification of $^{260}104$ due to a sharp difference in the volatility of their chlorides. NSA

N67-29340# Kernforschungszentrum, Karlsruhe (West Germany).

DETERMINATION OF THE RADIOCHEMICAL YIELD FOR THE FORMATION OF TRIPLET MOLECULES IN THE RADIOLYSIS OF BENZENE [BESTIMMUNG DER STRAHLENCHEMISCHEN AUSBEUTE FUER DIE BILDUNG VON TRIPLETTMOLEKUELEN BEI DER RADIOLYSE VON BENZOL]

L. I. Samochvalova and V. A. Krongauz [1966] 8 p refs Transl. into GERMAN from Dokl. Akad. Nauk SSSR (Moscow), v. 168, 1966 p 154–157

(KFK-TR-213) CFSTI: HC $3.00/MF $0.65

For determination of the radiochemical yields of triplet molecules from γ irradiation of benzene, the benzene-sensitized cis–trans isomerization of stilbene was used. The dependence of the yield of the cis- and trans-isomers on the stilbene concentration in benzene and cyclohexane was shown. The isomerization increased with concentrations up to 10^{-3}M. At higher concentrations the yields reached a limiting value and remained constant. The limiting value was larger in cyclohexane than in benzene. At stilbene concentrations under 10^{-3}M there was a concurrent interaction between the primary free radicals and the stilbene with radical recombination. At higher stilbene concentrations all primary free radicals appearing in the solvent participated in the isomerization of the stilbene. Radiolysis of stilbene in the presence of vinyl monomers was also studied. At sufficiently high concentrations of the monomer, there was practically no isomerization of the stilbene in cyclohexane. A G(T) value of $\approx$0.4 to 0.5 was obtained for the yield of triplet molecules. NSA

N67-29382# Texas A&M Univ., College Station.

SAMPLE PREPARATION TECHNIQUES

J. S. Hislop, J. Cuypers, and A. Reinoesk *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 23–38 ref (See N67-29389 16-24)

In view of the importance of sample preparation and the required libraries (standards) in the comparator method of activation analysis, studies were undertaken to investigate the reproducibility of the standard preparation techniques, and to modify them, if necessary. Summarized are investigations conducted to improve the methods of standard and sample preparation. Discussed are electrical and modified flame methods for sealing polyethylene vials; and studies of the adsorption of standards and the statistical reliability in their calibrations which focus on aluminum adsorption on glass as a function of time; and dilution, pipetting and calibration techniques for the preparation of solution standards. S.C.W.

N67-29428*# Battelle Memorial Inst., Columbus, Ohio.

CONTINUATION OF THE INVESTIGATION OF THE REACTION OF TITANIUM WITH HYDROGEN

B. J. Koehl, W. Hodge, D. N. Williams, and E. S. Bartlett 15 May 1967 45 p refs

(Contract NAS9-6565)

(NASA-CR-65638) CSCL 07B

Continuing research in the reaction of titanium with hydrogen is reported, with emphasis on two aspects: (1) the effect of stress on the titanium–hydrogen reaction at low temperatures and 1 atmosphere pressure of hydrogen and (2) the significance of hydrogen pressure, surface cleanliness, and microstructure on the titanium–hydrogen reaction at hydrogen pressures above atmospheric. Twenty-six experimental runs were made at 80° to 140°F with Ti–50A and Ti–6Al–4V specimens exposed to hydrogen at atmospheric pressure, in which the specimens were stressed by bending over a mandrel by the oscillation of large magnets outside the reaction tube. No reaction occurred with any abraded and stressed Ti–50A specimens; however, one specimen of Ti–6Al–4V reacted. In the pressure studies, a quartz–spring pressure balance was used to investigate the effect of hydrogen pressure, microstructure, and stress on the titanium–hydrogen reaction, as well as the hydriding of aircraft titanium tubing. Future plans for research are outlined, and tables of experimental results are appended. L.E.W.

N67-29438*# Temple Univ. Research Inst., Philadelphia, Pa.

STUDY OF METHODS OF ENHANCING THE VISIBILITY OF ROCKET SMOKE TRAILS Final Report

W. J. Murphy, and C. S. Stokes 15 May 1967 39 p

(Contract NAS1-4849)

(NASA-CR-66360; RITU-1967-10) CSCL 07D

The possibility of dyeing smoke trails for the photographic determination of wind velocity was investigated. The addition of dyes and inorganic coloring agents, the reaction of $TiCl_4$ with an organic compound, and reactions involving $POCl_3$ and PCl_5 were studied. Tests were conducted at simulated altitude and humidity, and the relative color of $TiCl_4$ smokes was measured using reactants. It was found that the dyes used were unsuccessful for coloring the smoke, and that few dyes were soluble in $TiCl_4$. It was also determined that two-component systems, such as acetone—$TiCl_4$ and acetic acid—$TiCl_4$, show some promise of producing a yellow colored smoke. N.E.N.

N67-29436# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.

ELECTROCHEMICAL CHARACTERIZATION OF NON-AQUEOUS SYSTEMS FOR SECONDARY BATTERY APPLICATION Quarterly Report, Feb.–Apr. 1967

M. Shaw, O. A. Paez, R. J. Radkey, and A. H. Remanick 17 Apr. 1967 81 p refs

(Contract NAS3-8509)

(NASA-CR-72256; QR-4) CSCL 07D

Multisweep cyclic voltammograms have been obtained for an additional two hundred systems comprising the oxides, chlorides, and fluorides of silver, copper, nickel, and cobalt in acetonitrile, butyrolactone, dimethylformamide, and propylene carbonate solutions of chlorides, perchlorates, and fluorides. Voltammograms are presented for thirty of these systems. Tabular data includes peak current density, sweep index, charge-to-discharge peak displacement, coulombic ratio, and discharge capacity. Systems exhibiting no anodic or no cathodic peaks are listed, as well as those causing instrument overload due to a combination of high current and relatively low conductance. Author

N67-29462# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.

LABORATORY FOR RESEARCH ON THE STRUCTURE OF MATTER Sixth Annual Technical Report, 1 Jul. 1965–30 Jun. 1966

John N. Hobstetter 30 Jun. 1966 178 p refs

(Contract ARPA SD-89)

(AD-648126) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. BASIC CHEMISTRY AND SYNTHESIS p 1–15 refs (See N67-29463 16-08)

2. ELECTRONIC PROPERTIES p 16–43 refs (See N67-29464 16-06)
3. INTERACTION OF MATTER AND RADIATION p 44–52 refs (See N67-29465 16-06)
4. MECHANICAL PROPERTIES p 53–62 refs (See N67-29466 16-32)
5. QUANTUM THEORY AND FUNDAMENTAL INTERACTIONS p 63–78 refs (See N67-29467 16-24)
6. STRUCTURE OF MATERIALS AND PHASE TRANSFORMATIONS p 79–97 refs (See N67-29468 16-06)
7. THERMODYNAMICS, KINETICS AND MASS TRANSPORT p 98–109 refs (See N67-29469 16-06)

N67-29463# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
BASIC CHEMISTRY AND SYNTHESIS
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 1–15 refs (See N67-29462 16-06)

Studies of the nature of chemical bonds, the mechanisms of chemical reactions, catalysis, and methods of chemical synthesis are described. Author

N67-29464# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
ELECTRONIC PROPERTIES
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 16–43 refs (See N67-29462 16-06)

This section of the research program includes studies of dielectric properties in relation to structure; of electron band structure of metals, alloys, and semiconductors; of electron transport mechanisms; of properties of magnetic materials; and of resonance phenomena. Author

N67-29465# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
INTERACTION OF MATTER AND RADIATION
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 44–52 refs (See N67-29462 16-06)

Radiation stability and radiation damage research is reported. Also considered are spectroscopy including infrared absorption, emission spectra and Raman spectra of molecules and crystals, and electron transitions in organic crystals. Author

N67-29468# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
STRUCTURE OF MATERIALS AND PHASE TRANSFORMATIONS
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 79–97 refs (See N67-29462 16-06)

The work described comprises all studies of atom positions both in bulk materials and thin films, of the rules that govern structure formation, and of all means by which structures are formed, controlled, or modified. Author

N67-29469# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
THERMODYNAMICS, KINETICS AND MASS TRANSPORT
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 98–109 refs (See N67-29462 16-06)

The studies included relate to measurement and calculation of energy changes during chemical reactions or changes of state, of rates of reaction or state change, and of the mechanisms and rates of movement of atoms in condensed phases. The phenomena included range from corrosion and electrochemistry, through vaporization and volatilization, to order-disorder phenomena. Author

N67-29521 Joint Publications Research Service, Washington, D. C.
STUDIES IN SINTERING, DESILICONIZING, AND FLUORINE BALANCE DETERMINATION
2 May 1967 36 p refs Transl. into ENGLISH from Tsvetn. Metal (Moscow), no. 2, Feb. 1967 p 42–62 refs
(JPRS-40870; TT-67-31512) CFSTI: $3.00

CONTENTS:

1. KINETICS OF THE SINTERING PROCESS IN NEPHELINIC CHARGES B. I. Arlyuk, V. A. Mazel', and Ye. I. Khodorov p 1–11 refs (See N67-29522 16-06)
2. VERIFYING THE METHOD OF NON-AUTOCLAVE DESILICONIZING OF ALUMINATE SOLUTIONS I. Z. Peyzner p 12–25 refs (See N67-29523 16-06)
3. CALCULATION METHOD FOR DETERMINING FLUORINE BALANCE IN THE ELECTROLYSIS OF ALUMINUM S. S. Solntsev p 26–30 refs (See N67-29524 16-06)

N67-29522 Joint Publications Research Service, Washington, D. C.
KINETICS OF THE SINTERING PROCESS IN NEPHELINIC CHARGES
B. I. Arlyuk, V. A. Mazel', and Ye. I. Khodorov *In its* Studies in Sintering, Desiliconizing, and Fluorine Balance Determination 2 May 1967 p 1–11 refs (See N67-29521 16-06)

It was established that sintering of nephelinic charges is limited by the diffusion of CaO in liquid and solid phases, and also by the chemical reaction rate of the interaction with nepheline. A system of equations is derived, describing the kinetics of the reaction of nepheline with CaO in the charge, and a determination is made of effective values of solubility of CaO in the liquid phase, coefficients of diffusion of CaO in the liquid and solid phases, and the chemical reaction rates of CaO with nepheline. Variation in the sizes of limestone particles in the limits of 40–100 microns was found to have a greater effect on the sintering rate than variation of nepheline particle size within the same limits. The intensifying effect of Na_2SiF_6 additions and coal on the kinetics of sintering was shown through an increase in the diffusion coefficients in the liquid phase. Author

N67-29523 Joint Publications Research Service, Washington, D. C.
VERIFYING THE METHOD OF NON-AUTOCLAVE DESILICONIZING OF ALUMINATE SOLUTIONS
I. Z. Peyzner *In its* Studies in Sintering, Desiliconizing, and Fluorine Balance Determination 2 May 1967 p 12–25 refs (See N67-29521 16-06)

Experiments are described which verify the results of laboratory investigations under industrial conditions. A continuous-action device was installed consisting of five reactors fitted with chain mixers, a single-stage thickener, pumps, and a cylindrical vacuum-filter. Experiments to verify the effect of the disperse composition of drilling mud on the extent of desiliconizing are also described. Extensive graphs and tables of the results are included. Among the conclusions are the following: (1) An industrial scheme of desiliconizing aluminate solutions at atmospheric pressure in a mixer is established. (2) Stability for individual tests running as long as ten days was demonstrated. (3) Optimal conditions of nonautoclave desiliconizing were determined. (4) Aluminate solutions are readily semidesiliconized in the second stage with limestone. N.E.N.

N67-29524 Joint Publications Research Service, Washington, D. C.
CALCULATION METHOD FOR DETERMINING FLUORINE BALANCE IN THE ELECTROLYSIS ALUMINUM
S. S. Solntsev *In its* Studies in Sintering, Desiliconizing, and Fluorine Balance Determination 2 May 1967 p 26–30 refs (See N67-29521 16-06)

The parameters affecting the fluorine balance in the electrolytic production of aluminum from aluminum oxide are investigated to make possible a reduction in the consumption of fluoride salts. It was established that the proportion of CF_4 in the anodic gas depends only on the anode type. Consumption of fluorine in the form of hydrogen fluorine and fluorine volatiles was found to depend mainly on the cryolite ratio and the temperature of the electrolyzer. It was further concluded that fluorine consumption is reduced when the service life of disconnected electrolyzers is increased from three to four years. N.E.N.

N67-29527 Joint Publications Research Service, Washington, D. C.

SOVIET RESEARCH ON ION-EXCHANGE TECHNOLOGY

28 Mar. 1967 37 p refs Transl. into ENGLISH from the book "Ionoobmen. Tekhnol." Moscow, 1965

(JPRS-40432; TT-67-31077) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. CONTINUOUS COUNTERCURRENT ION EXCHANGE METHOD OF SEPARATING CESIUM AND RUBIDIUM I. A. Kuznetsov, G. M. Panchenkov, and N. P. Savenoka p 1–10 refs (See N67-29528 16-06)

2. SEPARATING SODIUM AND LITHIUM IONS ON A CATIONITE BY THE DISPLACEMENT ELECTROCHROMATOGRAPHY METHOD A. A. Shabanov, V. I. Gorshkov, G. M. Panchenkov, and An. V. Makarov p 11–18 refs (See N67-29529 16-06)

3. SELECTIVE SORPTION OF PROTIUM OXIDE WITH SWELLING OF IONITE RESINS IN HEAVY WATER SOLUTIONS V. P. Meleshko, O. N. Myagkov, and N. T. Kochkina p 19–31 refs (See N67-29530 16-06)

N67-29528 Joint Publications Research Service, Washington, D. C.

CONTINUOUS COUNTERCURRENT ION EXCHANGE METHOD OF SEPARATING CESIUM AND RUBIDIUM

I. A. Kuznetsov, G. M. Panchenkov, and N. P. Savenoka *In its* Soviet Res. on Ion-Exchange Technol. 28 Mar. 1967 p 1–10 refs (See N67-29527 16-06)

The separation was carried out in a countercurrent unit consisting of two columns 160 cm long and 25 mm in diameter, providing smooth flow of ionite toward the solution layer. The equilibrium constants of the exchange of Cs^+ for Rb^+ were determined for 0.1 N solutions with various Cs^+/Rb^+ ratios. The hydrogen form of cation-exchange resin was selected for continuous frontal separation. The equilibrium of the Ba^{2+}–Cs^+ exchange and separations without the use of auxiliary ions were also investigated. The experimental procedures and results are discussed, and the data are graphed. N.E.N.

N67-29529 Joint Publications Research Service, Washington, D. C.

SEPARATING SODIUM AND LITHIUM IONS ON A CATIONITE BY THE DISPLACEMENT ELECTROCHROMATOGRAPHY METHOD

A. A. Shabanov, V. I. Gorsakov, G. M. Panchenkov, and An. V. Makarov *In its* Soviet Res. on Ion-Exchange Technol. 28 Mar. 1967 p 11–18 refs (See N67-29527 16-06)

The conditions under which the erosion of the zones could be reduced to a minimum were investigated. The study was conducted with cation-exchange resin with 8% divinylbenzene with a grain size of 200 mesh, and a mixture of lithium and sodium ions at approximately 1:1 ratio. The dependence of the separation on current density and concentration of the displacing solution were determined, and the data are graphed. Isotherms of the Li^+–Cd^{2+} exchange are also presented for different concentrations of aqueous chloride solutions. N.E.N.

N67-29530 Joint Publications Research Service, Washington, D. C.

SELECTIVE SORPTION OF PROTIUM OXIDE WITH SWELLING OF IONITE RESINS IN HEAVY WATER SOLUTIONS

V. P. Meleshko, O. N. Myagkov, and N. T. Kochkina *In its* Soviet Res. on Ion-Exchange Technol. 28 Mar. 1967 p 19–31 refs (See N67-29527 16-06)

The partial separation of deuterium oxide and protium oxide from their solution using the capability of ionite resins to swell was studied. Details are presented on the experiments conducted under dynamic conditions, and the results are tabulated and graphed. It was found that the separation factors of D_2O and H_2O are considerably lower when the separation of free water was accomplished by centrifuging and the separation was more complete than when filtered under rarefaction. N.E.N.

N67-29533 Joint Publications Research Service, Washington, D. C.

ORGANIC AND PHYSICAL CHEMISTRY REPORTS OF THE USSR ACADEMY OF SCIENCES

15 Mar. 1967 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk (Moscow), v. 172, no. 2, 1967 p 353–356, 383–385

(JPRS-40270; TT-67-30916) CFSTI: $3.00

CONTENTS:

1. DERIVATIVES OF TRICHLORETHYLPHOSPHINIC ACIDS AND SOME OF THEIR PROPERTIES K. V. Nikonorov, E. A. Gurylev, F. F. Fakhrislamova, T. V. Rospopova, L. G. Urazayeva et al p 1–6 refs (See N67-29534 16-06)

2. EXCITATION OF EXPLOSION UPON SHUTTING OF CAVITATION BUBBLES IN LIQUID EXPLOSIVES V. Ye. Gordeyev, A. I. Serbinov, and Ya. K. Troshin p 7–12 refs (See N67-29535 16-06)

N67-29534 Joint Publications Research Service, Washington, D. C.

DERIVATIVES OF TRICHLORETHYLPHOSPHINIC ACIDS AND SOME OF THEIR PROPERTIES

K. V. Nikonorov, E. A. Gurylev, F. F. Fakhrislamova, T. V. Rospopova, L. G. Urazayeva et al *In its* Org. and Phys. Chem. Rept. of the USSR Acad. of Sci. 15 Mar. 1967 p 1–6 refs (See N67-29533 16-06)

A previously developed method of condensing hypophosphorus acid with chloral was used to prepare condensation products of hypophosphorus acid with one mole of chloral—β, β, β-trichlor-α-hydroxyethylphosphinous acid (I)—and two moles of chloral—bis-(β,β,β-trichlor-α-hydroxyethyl)-phosphinic acid (II). Several acyl derivatives of the acid (II) were prepared. The method of obtaining the reactions is described, and the resulting compounds are listed in tabular form. Since all the synthesized compounds were acids, they were treated with triethylamine and converted into salts of substituted ammonium. The prepared compounds were then tested by studying the toxicity on white mice with intravenous injection, anticholinesterase activity by the Hestrin method, action on the blood pressure and respiration of rabbits, action on the smooth muscle of the rabbit intestine, and antimicrobial properties in vitro. It was found that the tested compounds possess antimicrobial properties to a degree and that the compounds are of low toxicity and have a definite biological action. I.E.W.

N67-29535 Joint Publications Research Service, Washington, D. C.

EXCITATION OF EXPLOSION UPON SHUTTING OF CAVITATION BUBBLES IN LIQUID EXPLOSIVES

V. Ye. Gordeyev, A. I. Serbinov, and Ya. K. Troshin *In its* Org. and Phys. Chem. Rept. of the USSR Acad. of Sci. 15 Mar. 1967 p 7–12 refs (See N67-29533 16-06)

The possibility of the excitation of explosion by cavitation is discussed. The difficulties previously encountered in attempts to cause cavitation, which should be easily observed as well as consistent in initiating explosion, were overcome with the use of a simple device, which is depicted and described. The device consists of a funnel mounted on the test tube containing the explosive liquid and a piston, which forces a part of the liquid from the test tube into the funnel, which is positioned at a small depth in the test tube. When the piston is sharply jerked upward, cavitation bubbles form in the test tube and grow. After the piston is thrown out of the test tube, the liquid in the funnel bursts into the liberated space, and a hydraulic shock takes place during which the pressure of the liquid rises sharply and the cavitation bubbles that formed in the test tube begin to shut. Experiments conducted with a solution of benzene in tetranitromethane and with nitroglycerin are described and depicted. It was concluded that the cavitation excitation of explosion is possible and that it has a purely thermal nature. L.E.W.

N67-29558# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
SPECIES DIFFUSION IN THE FROZEN LAMINAR BOUNDARY LAYER ON A CATALYTIC FLAT PLATE
R. J. Vidal Arnold AF Station, Tenn., Arnold Eng. Devel. Center, Apr. 1967 34 p refs
(Contract AF 40(600)-1093)
(AEDC-TR-67-88; AG-1905-A-2; AD-650766) CFSTI: HC $3.00/MF $0.65

A theoretical solution is presented for species diffusion in the compressible laminar boundary layer on a flat plate for frozen gas-phase chemistry. It is assumed that the recombination at the wall is a first-order reaction, and the chordwise concentration gradients are neglected. The solution parallels Crocco's treatment except for the assumption governing the viscosity variations with temperature. A modified Chapman-Rubesin constant is used here, and it is assumed that the product of the density and viscosity varies as a power of the static enthalpy. This makes it possible to closely approximate the actual rho mu- product in the vicinity of the wall. The solution for the species equation and the energy equation are obtained in terms of the shear in the boundary layer. The latter is determined following an empirical calculation used by Young. The result given here should be somewhat more general since the Prandtl number effects are included in a more complete fashion. The solutions for heat transfer and skin friction are compared with existing exact numerical solutions to show that they agree with typical errors of about 5 percent. Author (TAB)

N67-29586# Army Materials Research Agency, Watertown, Mass.
THE LINEAR SOLIDIFICATION OF BINARY SOLUTIONS
Eugene De Luca Nov. 1966 31 p refs
(AMRA-TR-66-34; AD-649845) CFSTI: HC $3.00/MF $0.65

The linear solidification of a dilute, binary solution is studied in this work. The results of Neumann and Schwarz on linear solidification of a pure substance are extended to solidification of binary solution. The redistribution of solute which occurs during solidification is given appropriate consideration in the treatment. The existence and extent of a region in the liquid phase wherein solidification is thermodynamically possible (supercooled boundary layer) are examined rigorously in some detail. Solidification of a binary solution from a circular cylindrical boundary and from a spherical boundary is also considered. In each case, the problem is reformulated as a set of integral and integrodifferential equations, and an elementary numerical procedure is outlined for treatment of the transformed problem. Author (TAB)

N67-29588# Naval Research Lab., Washington, D. C.
PHOTODEGRADATION OF HIGH POLYMERS IN SOLUTION. PART 4: THE EFFECT OF ADDITIVES ON THE PHOTOLYSIS OF POLY(METHYL METHACRYLATE)
Robert B. Fox and Thomas R. Price 10 Mar. 1967 23 p refs
(NRL-6514; AD-649738) CFSTI: HC $3.00/MF $0.65

Poly(methyl methacrylate) was photolyzed by 2537A radiation at room temperatures in methylene chloride and in dioxane. The quantum yields for random scission in the absence of air in dioxane were 0.168 scission/quantum absorbed at an intensity absorbed by the polymer of 0.30 X 10 to the 16th power quanta/ml-min; in methylene chloride the corresponding data are 0.149 and 0.27 x 10 to the 16th power. The quantum yields in the presence of air are about half these yields. A wide variety of chemical additives in the polymer solutions were sensitizers or inhibitors of degradation. The strongest inhibitors were those additives whose lowest excited triplet levels were below about 23,000/cm, and the sensitizers were those additives whose lowest excited triplet levels were above 27,000/cm. By postulating electronic energy transfer via the lowest excited triplet levels as the mechanism for inhibition or sensitization a triplet is inferred for the polymer between 23,000 and 27,000/cm. As further evidence of this postulate a number of nitro compounds which would be expected to form triplets were found to show promise as inhibitors to the poly(methyl methacrylate) photolysis. Author (TAB)

N67-29616# Berg (T. G. Owe), Inc., Santa Ana, Calif.
INVESTIGATION OF KINETICS OF CONDENSATION Interim Report, 1 Jul. 1966–31 Jan. 1967
T. G. Owe Berg and D. C. George 1 Feb. 1967 16 p
(Contract DAAB06-67-C-0080)
(ECOM-0080-1; AD-650848) CFSTI: HC $3.00/MF $0.65

The primary objectives of this work were to investigate the operating conditions of the Aitken nucleus counter and to elucidate the basic mechanisms of condensation with a view to applications in cloud physics. The apparatus used in the study consisted of a Wilson-type cloud chamber in which the condensation phenomena could be observed by either high speed camera or light extinction measurements. In this manner rates of condensation were noted and also the effect of nucleation by solid particulates of reacting gases such as ammonia and hydrochloric acid was studied. Author (TAB)

N67-29641# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy.
PROTON ADSORPTION AT THE FERRIC OXIDE/AQUEOUS SOLUTION INTERFACE. II: ANALYSIS OF KINETIC DATA
Y. G. Berube, G. Y. Onoda, Jr., and P. L. de Bruyn Mar. 1967 25 p refs
(Contract Nonr-1841(86))
(TR-2; AD-650035) CFSTI: HC $3.00/MF $0.65

A quantitative study of the time-dependent abstraction of H(+) and OH(-) ions from solution by crystalline Fe2O3 precipitates is reported. The experimental information was gathered by potentiometric titrations of oxide suspensions, by observation of pH drift with time after rapid displacement of the pH of the solution initially equilibrated with the solid at the zpc, and by tritium exchange between the tritiated oxide and pure water. Author (TAB)

N67-29643# Naval Research Lab., Washington, D. C.
FILTER PACK TECHNIQUE FOR CLASSIFYING RADIOACTIVE AEROSOLS BY PARTICLE SIZE, PART 5 Final Report
L. B. Lockhart, Jr., R. L. Patterson, Jr., and A. W. Saunders, Jr. 1 Mar. 1967 21 p refs
(NRL-6520; AD-649728) CFSTI: HC $3.00/MF $0.65

During the past several years, a number of collections of radioactive aerosols in the atmosphere have been made on packs of filters, of different characteristics, through which an air stream passes sequentially. The radioactivity distribution on the filters has been related to the sizes of the particulate matter in the atmosphere

with which the radioactivity was associated. Conditions have been developed for obtaining size distributions in 3 or 4 size groups, in the submicron range, through use of packs consisting of 3 or 4 well-characterized filter media operated in two convenient air flow regimes, 60-70 cm/sec and 145 cm/sec. Simple two-filter packs can be employed to monitor the behavior of particulate matter in a restricted size range (e.g., either the >1.0 micron-diameter component or the <0.3 micron-diameter component). The general method is applicable to the sizing of any aerosol material for which suitable analytical techniques are available. Gross beta activity levels and concentrations of specific radionuclides in the atmosphere at Washington, D. C., have been documented for the period January 1965 through July 1966. Author (TAB)

N67-29646# Monsanto Research Corp., Dayton, Ohio.
INVESTIGATION OF HIGH TEMPERATURE GAS CHROMATOGRAPHY SUBSTRATES Interim Report, 23 Dec. 1965–23 Dec. 1966
William D. Ross and Geneva W. Harris Wright-Patterson AFB, Ohio. ARL. Jan. 1967 27 p refs
(Contract AF 33(615)-1176)
(ARL-67-0004; AD-649618) CFSTI: HC $3.00/MF $0.65

Amounts of beryllium as small as 4 x 10 to the -13th power g can be detected by electron capture gas chromatography of beryllium(II) trifluoroacetylacetonate. Calibration curves were obtained over the range from 8 x 10 to the -13th power to 4 x 10 to the -11th power g of beryllium. A quantitative method for the determination of beryllium in aqueous solution by solvent extraction, followed by gas chromatography, is described. Radioactive Be7 was used to determine the distribution of beryllium between the organic and aqueous phases in the solvent extraction step and to establish whether traces of beryllium were lost by adsorption. Comparative studies of the response of the electron capture detector for aluminum(III) and chromium(III) trifluoroacetylacetonates and heptafluorodimethyloctanedionates were made. The detector response is approximately three times greater for the trifluoroacetylacetonates as compared to the heptafluorodimethyloctanedionates. The gas chromatographic analysis of rare earth metal tetramethylheptanedionates was initiated. Partial separation of the yttrium and europium tetramethylheptanedionates was achieved. Author (TAB)

N67-29647 Mare Island Naval Shipyard, Vallejo, Calif. Chemical Lab.
PROPERTIES OF WELL CRYSTALS AS GAMMA-RAY DETECTORS
Paul T. Wagner Mar. 1967 18 p refs
(Rept.-1500-562-67; PR-1; AD-649964) CFSTI: HC $3.00/MF $0.65

Several parameters were investigated for gamma-ray counting with a 3 x 3-inch NaI(Tl) well-type scintillation detector. For normally encountered gamma-ray energies, volumes from 1 to 3 ml (using a 10-ml vial) can be counted with little efficiency loss; for standardization a 2-ml volume is proposed. Instrument response when counting showed essentially no efficiency loss for dead times up to 20 percent; for standardization a dead time below 10 percent is proposed. A set of equations based on peak areas was formulated for the unscrambling of composite spectra, and a least squares solution to these equations is provided. Resolution of either set of equations requires a computer. Author (TAB)

N67-29662# Picatinny Arsenal, Dover, N. J.
WETTING OF HIGH AND LOW ENERGY SURFACES BY LIQUID ADHESIVES AND ITS CORRELATION TO BOND STRENGTH
Modesto J. Barbarisi Jan. 1967 29 p refs
(PA-TR-3456; AD-651093) CFSTI: HC $3.00/MF $0.65

An investigation was conducted to determine the relationship between adhesive wetting and adhesion to certain adherends. The degree of wetting was determined by measuring contact angles with a contact angle goniometer. The effects on contact angles of changing the surface treatment of the polyethylene and aluminum specimens was studied. Next the angles were changed by varying the adherend itself rather than just the surface preparation. Polyethylene, aluminum, and glass laminate were used for the purpose. Finally, the liquid adhesives themselves were changed in order to vary wetting and determine whether or not a specific relationship exists between wetting and bond strength. Adhesives used were (1) Eastman 910, a cyanoacrylate adhesive; (2) Epon 828/Versamid 140, a polyamide-modified bisphenol A type epoxy; and (3) Kopoxite 159/Versamid 140, a polyamide-modified resorcinol-type epoxy. Author (TAB)

N67-29664# Marine Engineering Lab., Annapolis, Md.
DETERMINATION OF THE SURFACE AREAS OF SELECTED SOLIDS
Norman L. Hatfield Mar. 1967 32 p refs
(MEL-27/67) CFSTI: HC $3.00/MF $0.65

Because of the many applications of solid-gas interface phenomena in Navy technology, a study was made of methods for the determination of the surface area of solids with the purpose of investigating new adsorbents. After a review of the literature on the many techniques for measuring surface area, the dynamic flow methods using the Brunauer–Emmett–Teller theory of molecular adsorption was selected. The error in this method is less than 5 percent, and the instrumentation required is not overly complicated. The instrumentation was set up, sample treatment and measuring techniques were standardized, and the surface areas of selected materials were determined. The values ranged from a high of almost 1000 square meters per gram for activated carbon to a low of 0.078 square meters per gram for glass beads. Author (TAB)

N67-29702# California Univ., Riverside.
P-V-T RELATIONS IN HIGH MOLECULAR WEIGHT AROMATIC HYDROCARBONS Final Report
Hartland Schmidt, Jack Opdycke, Ronald K. Clark, and Charles F. Gay Sep. 1966 138 p refs
(Contract AT(11-1)-34)
(TID-23757) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: structural effects and properties of oligomers of interest in separations and statistical thermodynamics of liquid polyphenyl chain molecules and their mixtures. The contributions of the chain length, chain structure, internal rigidity, segment potential function, and combinatorial configurational entropy to the properties of liquid short chain molecules and their mixtures, as exemplified by the polyphenyl series, were found to be significant in terms of general models of simple chain molecules. The pressure-volume-temperature properties of liquid benzene and 1,3,5-triphenylbenzene were measured. Volume data were fit to an equation containing terms up to quartic in temperature and quadratic in pressure and to the Tait equation. Data on biphenyl, m-, o-, and p-terphenyl were also fit to the equations. Data on polyphenyls were then treated by the statistical thermodynamic corresponding states models. The infinite dilution thermodynamic properties of benzene-polyphenyl systems were investigated by means of gas–liquid chromatography. Combination of the results yielded information on intermolecular potential energy interactions between segments on the different molecules present in the mixture. NSA

N67-29703# Technische Hochschule Hannover (West Germany). Institut fuer Technische Chemie.
SOLIDS MIXING IN GAS-FLUIDIZED BEDS WITH A CONTINUOUS FEED OF SOLIDS [FESTSTOFFVERMISCHUNG IN GASDURCHSTROEMTEN WIRBELSCHICHTEN MIT KONTINUIERLICHEM FESTSTOFFDURCHSATZ]

G. Alfke and G. Gaertner Nov. 1966 28 p refs In GERMAN; ENGLISH summary
(BMwF-FBK-66-34) CFSTI: HC $3.00/MF $0.65

The quantitative description of solids mixing in fluidized beds with continuous charge and discharge of the solid material is important for chemical engineering purposes. Therefore, residence time distributions of the solids were measured to calculate coefficients of axial solids mixing. The beds used in the study were 10 cm in dia and 8.5, 14.5, and 34.5 cm in height; sand of an average particle dia of 250 μm was fluidized with air. The mixing coefficients obtained increased with the rate of solids feeding and with the height of the bed; the fluidizing gas velocity did not influence the coefficients. Furthermore, the data indicated that fluidized beds have to be considered as heterogeneous systems with regard to solids mixing. Author (NSA)

N67-29705# Comitato Nazionale per l'Energie Nucleare, Rome (Italy).
VOLUMETRIC FRACTION MEASUREMENT OF VAPOR BY THE γ ATTENUATION METHOD [MISURA DELLA FRAZIONE VOLUMETRICA DI VAPORE COL METODO DELL'ATTENUAZIONE γ] Progress Report, 30 Sep. 1965
P. Lupoli and R. Festoso 1966 59 p refs In ITALIAN
(RT-ING-(66)12)

Results are presented of void fraction measurements by the γ-ray attenuation method in plexiglass models of rectangular and tubular channels. The best conditions of measurement are investigated and the analysis of errors is made for each test section. Author (NSA)

N67-29714# Purdue Univ., Lafayette, Ind. Dept. of Chemistry.
THE CHEMISTRY AND NUCLEAR CHEMISTRY OF THE HEAVY ELEMENTS Annual Summary Report, 1 Feb. 1966–31 Jan. 1967
J. W. Cobble, ed. 1 Feb. 1967 22 p
(Contract AT(11-1)-347)
(COO-347-28) CFSTI: HC $3.00/MF $0.65

Developments are reported for studies on: ternary fission in ^{238}U, ^{235}U, and ^{232}Th; ternary and binary fission in ^{238}U; charge distribution in ^{237}Np and ^{239}Pu fission; mass distribution in ^{237}Np and ^{238}Pu fission; fission excitation functions of Re, Lu, and Tm; fission of Ir and Re; search for polymeric neutrons; neutron emission in charged particle reactions; entropy in the neptunyl ion; potential of the NpO_2/NpO_2^+ electrode; thermodynamics of Pu^{3+}(aq.); magnetic entropy of aqueous rare earth ions; and development of low level γ–γ coincidence counter. NSA

N67-29715# Centro Informazioni Studi Esperienze, Milan (Italy).
REVERSED-PHASE PARTITION CHROMATOGRAPHY IN INORGANIC CHEMISTRY: A SURVEY ON RESULTS OBTAINED AT CISE
Enrico Cerrai Oct. 1966 46 p refs
(CISC-103)

Methods for the separation of chemical elements and analogies between ion exchange liquid–liquid systems and reversed-phase chromatography are described. Different eluents, such as bis(2-ethylhexyl) phosphate, tri-n-octylamine, and tri-n-octylphosphine oxide, were used for the chromatographic separations. Mechanisms for the systems are given. NSA

N67-29748# Oklahoma Univ., Norman. School of Chemical Engineering and Materials Science.
DIFFUSION IN BINARY LIQUID METAL SYSTEMS Progress Report, 1 Feb. 1966–1 Feb. 1967
Frank B. Canfield and Lloyd Edwin Trimble 1 Feb. 1967 99 p refs
(Contract AT(40-1)-3396)
(ORO-3396-2) CFSTI: HC $3.00/MF $0.65

Mathematical relationships were developed for binary diffusion to show: Fick's second law should be applied only to systems which have constant partial molal volumes; the equivalence of the mutual diffusion coefficients in the center of moles and center of volume systems; and Darken's equations can be derived without the restriction of constant or equal partial molal volumes. It is shown that Fick's diffusuion equation can be used to obtain binary diffusion coefficients from experimental data for either the volume or mole reference frame as long as the specific volume of the mixture follows a linear law over the concentration range employed. Mutual and self-diffusion coefficients were obtained for the liquid cadmium–lead system over the entire composition range at 623°K. The capillary reservoir technique was used employing ^{210}Pb and ^{115m}Cd as tracers. The self-diffusivities were found to be in agreement with data reported previously by others. Both isotopes were used to study the effects of overall concentration on the mutual diffusion coefficient. Several improvements in the capillary reservoir technique, which were necessary before mutual diffusivities could be obtained using this method, are described. Author (NSA)

N67-29758# Cornell Univ., Ithaca, N. Y.
F_3^+ CENTER IN NaF
Lynn F. Stiles, Jr. (M.S. Thesis) Feb. 1967 69 p refs
(Contract AT(30-1)-3464)
(NYO-3464-6) CFSTI: HC $3.00/MF $0.65

Spectral studies were made on F_3^+ centers radioinduced in NaF by X-rays at room temperature. The location of the 5456-Å zero-phonon line and its associated band, and the results of uniaxial stress measurements in absorption and emission very strongly support an ionized R-center model for this center. The location of the 0.52-μ absorption band compared favorably with the transition energy calculated for the continuum model for the trigonal F_3^+ center. The energy calculation also indicated that the lowest allowed optical transition is an $A \rightarrow E$ transition. Uniaxial stress splittings in absorption verified this assignment. Also, the stress induced polarization of the line in emission was consistent with that expected for the degenerate excited state. NSA

N67-29769# Idaho Nuclear Corp., Idaho Falls.
GAS RELEASE AND COMPRESSION PROPERTIES IN BERYLLIUM IRRADIATED AT 600 AND 750°C
J. M. Beeston Feb. 1967 28 p refs
(Contract AT(10-1)-1230)
(IN-1057) CFSTI: HC $3.00/MF $0.65

He released from Be irradiated at 600 and 750°C was measured and related to a macro-diffusion coefficient, D. The value of D at 600°C was 6.8×10^{-14} and at 750°C was 1.13×10^{-9} cc/sec. The magnitude of the macro-diffusion coefficient at 750°C agrees with that predicted for gas diffusion in Be, but at 600°C agrees better with the self-diffusion coefficient. The activation energy, G, for release of He in the equation $D = D_0 \exp[(-G/kT)]$ is then 5 eV, which corresponds to the activation energy for re-solution processes. The recoil mechanism for He release was considered and was shown to be small when appreciable gas was released from the samples. The microstructure of the Be showed larger gas-bubble formation in the grain boundaries than within the grains. The compression yield strength of the Be irradiated to 1×10^{21} n/cc E>1 MeV at these temperatures increased only slightly, and although appreciable plastic deformation was sustained in the compression testing, the ultimate compression strength decreased. Author (NSA)

N67-29771# Union Carbide Nuclear Co., Oak Ridge, Tenn.
DETERMINATION OF SUBMICROGRAM QUANTITIES OF MERCURY IN WATER AND LITHIUM HYDROXIDE SOLUTIONS
M. S. Dill 28 Mar. 1967 14 p refs
(Contract W-7405-ENG-26)
(Y-1572) CFSTI: HC $3.00/MF $0.65

A method has been developed for determining submicrogram quantities of mercury in water and lithium hydroxide. The detection limit is 2×10^{-4} micrograms per milliliter. The mercury is reduced to metal and then expelled from a solution as vapor. The vapor is measured using an atomic absorption spectrophotometer. Author (NSA)

N67-29773# Naval Research Lab., Washington, D. C.
ORGANIC ADSORPTION AT ELECTRODES
B. J. Piersma 6 Mar. 1967 27 p refs
(NRL-6481; AD-649840) CFSTI: HC $3.00/MF $0.65

A review of the methods used to investigate the adsorption of organic compounds on solid metal electrodes shows that all of the available methods have very definite limitations. In the absence of a really good method, it is wise to employ all the available techniques which give complementary information. The available experimental information obtained from electrosorption measurements is compared with the data obtained from gas-phase studies. As an example of the difficulty encountered in making a comparison of gas-phase and electrosorption measurements, it is found in the study of adsorption energetics that the heats of adsorption are much lower in electrosorption. When water vapor is present, electrosorption is most likely similar to competitive gas-phase adsorption. A discussion of the energetics of adsorption clearly shows the competitive nature of adsorption at electrodes in solution. The adsorption characteristics of carbon monoxide, formic acid, methanol, ethanol, and hydrocarbons, especially ethylene, are discussed in some detail. A review of adsorption phenomena observed at open circuit shows that when a steady potential is established at platinized Pt electrodes in solutions of alcohols and aldehydes containing more than one carbon atom, processes of dehydrogenation and self-hydrogenation of the original substances and their decomposition products occur. Author (TAB)

N67-29775# Marine Engineering Lab., Annapolis, Md.
VAPOR PRESSURE OF FLUIDS IN HIGH-PRESSURE GAS ATMOSPHERES
Danute R. Ventriglio and Richard W. Mc Quaid Mar. 1967 56 p refs
(MEL-456/66; AD-649776) CFSTI: HC $3.00/MF $0.65

As part of the investigation of the critical parameters in the combustion of hydraulic fluids, experiments were conducted to verify the accuracy of the poynting equation which predicts the effect of inert gas pressure upon the vapor pressure of a liquid. In the initial experiments, relatively simple and noninteracting molecules were used, n-hexane and helium. Vapor-pressure measurements were performed at temperatures up to 25°F and at pressures up to 2000 pounds per square inch gage. Although the form of the poynting equation appeared applicable, it was necessary to add corrections for liquid compressibility, gas solubility in the liquid, and for intermolecular forces (by use of fugacity instead of vapor pressure). It appears that this method may be extended to more complicated molecular structures, and future work is planned to investigate the vapor pressure of liquids of increasing complexity under high inert gas pressure and eventually that of known hydraulic fluids. TAB

N67-29820# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
VOLUMETRIC FRACTION MEASUREMENT OF VAPOR BY THE γ ATTENUATION METHOD [MISURA DELLA FRAZIONE VOLUMETRICA DI VAPORE COL METODO DELL'ATTENUAZIONE γ] Progress Report, Period Ending 30 Jun. 1965
P. Lupoli 1966 59 p refs In ITALIAN
(RT/ING/66/11)

Problems related to void fraction measurement by the γ-ray attenuation method are examined. The measuring circuit and measurement technique are described and a detailed analysis is made of the most important parameters which define the calibration curve and the errors. Author (NSA)

N67-29822# Combustion Engineering, Inc., Windsor, Conn. Nuclear Div.
VANADIUM PURIFICATION Quarterly Progress Report, 1 Jul.–30 Sep. 1966
S. S. Christopher and S. Worcester Nov. 1966 39 p refs
(Contract AT(30-1)-3742)
(CEND-3742-288; QPR-1) CFSTI: HC $3.00/MF $0.65

A series of experiments was conducted to determine the most effective gettering element for purifying high interstitial V. The gettering elements evaluated were Al, Si, and Y. In addition to the preparation of unalloyed button melts of V, alloys containing 0.5, 1.0, and 1.5 wt % of each of the gettering elements were melted. For every composition, two buttons were arc melted. One button of each composition was subsequently remelted in an electron beam button furnace. All buttons were then evaluated for chemical composition, room temperature hardness, and microstructure. Preliminary data from this phase of the program are discussed. Author (TAB)

N67-29831# Loyola Univ., New Orleans, La.
ELECTRON SPIN RESONANCE AND OPTICAL ABSORPTION IN COMPACTED VITREOUS SILICA Final Report
David G. Keiffer 15 Dec. 1966 13 p refs
(Contract AT(40-1)-3303)
(ORO-3303-2) CFSTI: HC $3.00/MF $0.65

Color centers are produced very efficiently in compacted vitreous silica when irradiated by gamma rays. The rate of production was measured by electron spin resonance and the optical absorption of these centers was investigated in silica compacted at room temperature and at 500°C. The paramagnetic centers are identified as E' centers, which occur in irradiated uncompacted silica. There is, in addition to the E' optical absorption band, a new band at 260 mμ. The possibility that the production of E' centers is responsible for the rapid density changes that occur in irradiated compacted silica is discussed. Author (NSA)

N67-29832# Oak Ridge National Lab., Tenn.
EXCHANGE CURRENT MEASUREMENTS ON THE NICKEL–NICKEL(II) COUPLE IN MOLTEN FLUORIDES
Gleb Mamantov (Tenn. Univ., Knoxville), H. W. Jenkins, and D. L. Manning 5 Jan. 1967 5 p refs Presented at the 153rd Natl. Meeting, Am. Chem. Soc., Miami Beach, Fla. Prepared in cooperation with Tenn. Univ.
(Contract AT (40-1)-3518)
(ORO-3518-3; CONF-670401-7) CFSTI: HC $3.00/MF $0.65

A relaxation method was used to study the kinetics of the $Ni^{2+} + 2e \rightleftharpoons Ni$ process in molten $LiF–BeF_2–ZrF_4$ (65.6 to 29.4 to 5.0 mole %) at 497°C. From the plot of log i_0 (exchange current) vs log Ni (II), the transfer coefficient α was calculated as 0.23 (the slope is 1–α). The standard rate constant, k°, was found to be approximately 3.2×10^{-3} cm/sec, using the relation $i_0 = nFk^\circ C_{Ni(II)}^{1-\alpha}$. Exchange current data are tabulated. NSA

N67-29835# California Univ., Berkeley. Lawrence Radiation Lab.
THERMODYNAMICS OF SOLID AND LIQUID AuSn AND HEAT CONTENTS OF GOLD AND TIN
Elias Meyer Plaza Feb. 1967 44 p refs
(Contract W-7405-ENG-48)
(UCRL-17401) CFSTI: HC $3.00/MF $0.65

Using a diphenyl ether drop calorimeter, high temperature heat contents, $H_T - H_{298.15}$, of gold, in the range 404 to 1486°K; tin, in the range 405 to 924°K; and AuSn, in the range 416 to 917°K, have been measured. Smooth curves have been drawn through the experimental points, within a scatter of ±20 cal/g-atom, joining smoothly with data at low temperatures. Heats of fusion have been derived and tables of smoothed heat contents are presented. The data have been used to calculate the heat of formation of the alloy AuSn as a function of temperature, taking as

a basis the heat of formation at 273°K. The agreement obtained with heats of formation at 623°K and at 696°K previously reported was within 45 cal/g. atom, which is much less than the combined experimental uncertainties of the heats of formation and present data. This resolves discrepancies of 300 cal/g. atom or more, which existed among the mentioned heats of formation when previously available data for heat contents of AuSn were used. This is the significant evidence that indicates that the previous heat content data for AuSn were not accurate. Author (NSA)

N67-29836# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
ULTRAHIGH VACUUM TECHNIQUES Semiannual Report, 1 Jun.–30 Nov. 1966
R. Frauenfelder, W. J. Lange, and J. A. Singleton [1966] 35 p refs
(Contract AT(30-1)-2823)
(WERL-2823-24) CFSTI: HC $3.00/MF $0.65

Progress is reported on the independent determination of the permeation, solubility, and diffusion constants of hydrogen in tungsten and on the replacement of one adsorbed gas by a second gas from the gas phase. Measurements were also made on the nitrogen–tungsten and nitrogen–molybdenum systems. No measurable replacement was observed for the hydrogen–nitrogen system on tungsten in the study of gas replacement. NSA

N67-29846# Bureau of Mines, Pittsburgh, Pa.
NOBLE METALS, MOLYBDENUM, AND TUNGSTEN IN HYDROCARBON SYNTHESIS
J. F. Shultz, F. S. Karn, and R. B. Anderson Jul. 1967 25 p refs
(RI-BM-6974) CFSTI: HC $3.00/MF $0.65

Methanation catalysts were investigated in this report. The noble metals (platinum, palladium, ruthenium, rhodium, osmium, and rhenium), molybdenum, and tungsten were tested in hydrogenations of carbon monoxide and carbon dioxide at 21 atmospheres in a temperature range between 200° and 600°C. From the 8 metals studied, 25 catalysts representing 5 catalyst types were prepared and tested. The impregnated 0.5-percent-ruthenium catalyst proved to be the most active and versatile of all the catalysts produced. Tungsten and the noble metals other than ruthenium were low in activity and usually required temperatures above 500°C for appreciable production of hydrocarbons. Molybdenum was moderate in activity, but further improvement ig molybdenum catalysts seems possible. Author

N67-29847 Library of Congress, Washington, D. C. Aerospace Technology Div.
RESEARCH IN SPECIAL PURPOSE MATERIALS Surveys of Foreign Scientific and Technical Literature
John Kourilo and Boris Ofrossimow 27 Dec. 1966 60 p refs
(ATD-66-113)

A compilation of abstracts from Soviet open sources on special purpose inorganic and organic materials is presented. The abstracts contain information on window materials, heat shield materials, intermetallic compounds, electrochemical power supply systems, low density polymers, and polymers containing atomically dispersed metals. The appendices contain supplementary information on glass reinforced plastics and polymers with improved mechanical and thermal properties, and the thermal degradation of some heat resistant polymers. R.N.A.

N67-29851# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
AN ELECTROLYTIC PROCESS FOR PRODUCING DUCTILE VANADIUM
Kenneth P. V. Lei, Francis R. Cattoir, and Thomas A. Sullivan Jul. 1967 26 p refs
(BM-RI-6972)

Molten salt electrorefining in helium atmosphere cells as a means for the production of ductile vanadium was investigated. Electrolytes composed of NaCl–VCl_3, LiCl–NaCl–VCl_3, $BaCl_2$–KCl–NaCl–VCl_3, KCl–LiCl–VCl_3, and $CaCl_2$–NaCl–VCl_3 were tested. Two electrolytes, KCl–LiCl–VCl_3 and $CaCl_2$–NaCl–VCl_3, were selected for laboratory-scale production tests. A molten salt electrorefining process was developed for the production of ductile 99.6 percent vanadium from a commercial 90-percent grade. Using the $CaCl_2$–NaCl–VCl_3 electrolyte, and 87-percent recovery of ductile vanadium was made; an 85-percent recovery was made with the KCl–LiCl–VCl_3 electrolyte. Author

N67-29859# Union Carbide Nuclear Co., Oak Ridge, Tenn. Nuclear Div.
ISOSTATIC PRESSING BAG MATERIALS
J. L. Williams, comp. 10 Mar. 1967 50 p refs
(Contract W-7405-ENG-26)
(Y-1574) CFSTI: HC $3.00/MF $0.65

Properties required of gum rubber and polyvinyl plastisol bags used in isostatic pressing of powdered materials are detailed. Techniques used in fabrication of bags are given as are specifications for materials and equipment used. NSA

N67-29869# Iowa State Univ. of Science and Technology, Ames.
A STUDY OF THE EFFECTS OF IMPURITIES AND VACANCIES ON NUCLEAR MAGNETIC RESONANCE LINE SHAPES IN INTERMETALLIC COMPOUNDS
Ronald Glen Lecander (Ph.D. Thesis) Feb. 1967 171 p refs
(Contract W-7405-ENG-82)
(IS-T-122) CFSTI: HC $3.00/MF $0.65

Nuclear magnetic resonance (NMR) line shapes were analyzed to obtain the local variation of the hyperfine interaction due to impurities or vacancies in intermetallic compounds. The line shape of the Sc^{45} NMR was studied in $Sc(Ni_{1-x}Co_x)_2$ pseudobinary alloys at room temperature. For low cobalt concentrations, these line shapes were described by an inhomogeneous Knight shift due to the hyperfine interaction with an oscillating charge density surrounding the cobalt atoms. The magnitude and sign of these interactions were accounted for by resonant scattering of conduction electrons by virtual d levels of the cobalt atoms. The NMR of scandium was observed across the entire alloy system. A long range interaction was necessaary to describe the average Knight shift variation with composition. This shift was positive for low cobalt concentrations and became negative for very high cobalt concentrations. The latter were related qualitatively to the magnetic susceptibility but the relationship was not linear. The NMR of V^{51} was studied at room temperature in VC_x nonstoichiometric compounds for $0.75 < x < 0.88$. The shape of the resonance in $VC_{0.88}$ and the variation of the average Knight shift as a function of the carbon vacancy concentration was described by a hyperfine interaction due to first nearest neighbor carbon vacancies. An unsuccessful attempt was made to explain this local interaction by assuming the scattering of conduction electrons by the vacancy using a spherical square well potential. A negative Knight shift of −0.187% was obtained for V^{51} in stoichiometric VC, which could not be accounted for on the basis of susceptibility measurements. Author

N67-29876# Connecticut Univ., Storrs. Dept. of Physics.
INVESTIGATIONS OF RADIATION EFFECTS IN SOLIDS (METAL OXIDES, ALKALI AZIDES, AND BIFLUORIDES) BY ELECTRON SPIN RESONANCES Progress Report, Feb. 1, 1966–Jan. 31, 1967
Otis R. Gilliam 31 Jan. 1967 24 p
(Contract AT(30-1)-2047)
(NYO-2047-38) CFSTI: HC $3.00/MF $0.65

Spin-Hamiltonian parameters have been obtained for three paramagnetic defects in electron-irradiated $CaMoO_4$, two of which are also obtainable by gamma irradiation. Four radiation-generated

optical absorption bands are observed and studied with relation to the ESR spectra. Calcium molybdate doped with cerium ions has been examined to determine the spin-Hamiltonian parameters of Ce^{3+} ions substitutional for Ca^{2+}, and to examine the influence of charge compensation on the ESR spectra. A paper on F_2^- ions in electron-irradiated KHF_2 has been submitted and accepted for publication during the year. Similar studies are being conducted of irradiated $NaHF_2$ and other bifluorides. Experiments are in progress to determine the influence of sample source on the generation of defects in reactor-irradiated sapphire. Author (NSA)

N67-29877# Temple Univ. Research Inst., Philadelphia, Pa.
ANALYSIS OF EXPERIMENTAL DATA ON VISCOSITY AND SELF-DIFFUSION OF LIQUID METALS AND THEIR CORRELATION BY A SIMPLE KINETIC THEORY OF LIQUIDS
A. V. Grosse 7 Nov. 1966 57 p
(Contract AT(30-1)-2082)
(RITU-1966-30; NYO-2082-9) CFSTI: HC $3.00/MF $0.65

Measurements were made on viscosity for 27 metals and diffusion for 9. The experimental results were found to be in good agreement with elementary theory of viscosity and diffusion. It was concluded that the viscosities and diffusion coefficients of any metal can be calculated if the metal's melting point, atomic volume at the melting point, and Debye temperature are known. The elementary theory of viscosity and self-diffusion is briefly discussed. NSA

N67-29880 Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
TOPOLOGICAL STUDY OF THE SINTERING PROCESS
Annual Progress Report
Feb. 1967 102 p
(Contract AT(40-1)-2581)
(ORO-2581-1) CFSTI: HC $3.00/MF $0.65

Studies were made on the evolution of structure during sintering, the rate at which the structure evolves, and the relations that operate in the interplay between structure and kinetics. The application of the techniques of quantitative metallography to the study of sintering systems provided fairly detailed, reliable, and significant information about the variation of several geometric parameters as sintering proceeds. The average velocity of pore-solid interface was introduced as a new function to monitor sintering rate. Author

N67-29943 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
DETERMINATION OF COMPOUND FORMATION COEFFICIENTS. I: GENERAL PART [DETERMINATION DE COEFICIENTES DE FORMACION DE COMPLEJOS. I: PARTE GENERAL]
Carlos Bamberger and Antonio Sunar 1966 24 p refs In SPANISH
(CNEA-190)

General considerations are presented on the equilibrium and stability of chemical compounds in solutions. Thermodynamic and statistical data accompany the mathematical expressions given to determine the formation coefficients of compounds. Among methods considered to measure the formation coefficients are: Job's, Schubert's, and Kraus' methods. Transl. by RLI.

N67-29961# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
INVESTIGATION ON THE VOLATILITY OF ANTIMONY IN CHLORIDE–SULFATE MEDIUMS [UNTERSUCHUNGEN UEBER DIE FLUECHTIGKEIT VON ANTIMON IN CHLORID–SULFAT-MEDIEN]
P. Patek and E. Dammal 1967 15 p refs In GERMAN; ENGLISH summary Submitted for publication
(SGAE-CH-43/1967)

The volatility of antimony during evaporation of solutions containing chloride and sulfate was measured by labelling with ^{124}Sb. In pure chloride medium almost all antimony is volatilized whereas in pure sulfate medium the loss of antimony attained only 3%. In mixtures of both ions a clear dependence of the volatility from the ratio antimony:chloride:sulfate could be observed. Author

N67-29962# Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
EXTRACTION OF NIOBIUM
V. Pfeifer and H. Bildstein 1967 12 p refs Presented at Intern. Conf. on Solvent Extraction Chem., Goteburg, 27 Aug.–1 Sep. 1966
(SGAE-CH-44/1967) CFSTI: HC $3.00/MF $0.65

A liquid–liquid extraction method is presented for the separation of ^{97}Nb in a carrier-free form from many elements, including Zr, Hf, W and Fe. Nb is extracted into a solution of α-benzoinoxime in chloroform from aqueous hydrochloric acid, which also may contain small amounts of hydrofluoric or oxalic acid. A decontamination factor higher than 10^4 from Zr and other elements is achieved. If necessary, the back-extraction of Nb can be carried out with oxalic acid, H_2O_2 containing and other solutions. Author

N67-29964# Technische Hogeschool, Eindhoven (Netherlands).
AN ELECTROCHEMICAL AND OPTICAL INVESTIGATION OF THE ANODIC OXYGEN FILM ON PLATINUM
Wilhelmina Hermana Maria Visscher (Ph.D. Thesis) [1967] 97 p refs
CFSTI: HC $3.00/MF $0.65

Details are presented on the investigation of the anodic film which is formed on platinum during the redox reactions involving PtO_2–PtO and PtO–Pt. The quantity of oxygen formed by potentiostatic anodization was found to increase linearly with potential in the 0.9–1.7 volt region. The rate of formation of the oxygen layer depends on the anodic potential. The role the oxygen layer plays in determining the reaction is discussed. The theory of light reflected at a metal surface is given, along with the operation and theory of the ellipsometer to measure the phase retardation and relative change in amplitude ratio of parallel and perpendicular components of reflected light. The refractive index of Pt II oxide and Pt IV oxide were determined to 2.6 and 2.0 respectively. The anodic film's index of refraction was shown to be 3.0, agreeing reasonably with Pt-II oxide. N.E.N.

N67-29968# College of Aeronautics, Cranfield (England). Dept. of Materials.
A STUDY OF THE THERMAL DEGRADATION OF AN AMINE-CURED EPOXIDE RESIN AT TEMPERATURES BELOW 350° C
C. Patterson-Jones and D. A. Smith Jan. 1967 124 p refs
(CoA-NOTE-MAT-10) CFSTI: HC $3.00/MF $0.65

An epoxy resin made by the reaction of the diglycidyl either of bis-phenol A and diaminodiphenyl methane was thermally degraded in vacuo at temperatures between 200° C and 350° C. The effect of degradation was examined by means of measurement of changes in the dielectric properties of the material and also by examination of compounds evolved by the cured resin. Definite evidence for the evolution of N-methyl aniline and N:N-dimethylaniline is advanced and added evidence for a dehydration reaction is put forward. Possible degradation mechanisms are discussed. Author

N67-29975# Bureau of Mines, Bartlesville, Okla. Research Center.
SYNTHESIS OF CYCLIC SULFIDES

Ralph L. Hopkins, R. W. Higgins, H. J. Coleman, C. J. Thompson, and H. T. Hall Jul. 1967 23 p refs
(BM-RI-6970) CFSTI: HC $3.00/MF $0.65

Some typical thiacyclopentanes and thiacyclohexanes were synthesized to provide reference compounds needed for the identification of sulfur compounds in crude oils. Two general methods of synthesis were employed: (1) cleavage of 2-alkyltetrahydropyrans with hydrogen bromide followed by the reaction of the resulting dibromoalkanes with sodium sulfide and (2) the catalyzed reaction of cyclic ethers or 1,4- or 1,5-alkanediols with hydrogen sulfide. Both methods produced mixtures of 2-alkylthiacyclopentanes and 2-alkylthiacyclohexanes with 2-alkyltetrahydropyran as the starting material. The structures of the reaction products were established by analysis for sulfur; desulfurization; gas-liquid chromatography (GLC); mass, infrared, and nuclear magnetic resonance (NMR) spectra; and an alternate synthesis. The synthesis of the cyclic sulfides contributed substantially to the identification of 10 members of this class of sulfur compounds in crude oil. Author

N67-30007* Hughes Aircraft Co., Culver City, Calif.
LITERATURE REVIEW OF THE COMPATIBILITY OF COMMERCIAL MATERIALS WITH ETHYLENE OXIDE-FREON 12 STERILANT GAS MIXTURE
R. F. Rydelek Jan. 1965 9 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951003)
(NASA-CR-85235; Rept.-2748.40/910) CFSTI: HC $3.00 CSCL 07B

The literature published after January 1962 was reviewed to uncover information on the compatibility of commerical materials with an ethylene oxide-Freon 12 gas mixture. Ethylene oxide is capable of producing changes in material properties by reacting directly with base material or with impurities included during the manufacturing process. Because the reaction process is diffusion dependent, permeability of materials to the gas is an important factor. Freon 12 has solvent properties and tends to produce swelling in some elastomers. The majority of materials appearing on the first list should undergo relatively small change when exposed to sterilant gas at room temperature. Author

N67-30045# France. Ministere de l'Air, Paris.
STUDY OF THE FORMATION AND EVOLUTION OF THE POLYGONAL STRUCTURE IN ALUMINUM AND ALUMINUM–ZINC ALLOYS [ETUDE DE LA FORMATION ET DE L'EVOLUTION DE LA STRUCTURE POLYGONISEE DANS L'ALUMINIUM ET LES ALLIAGES ALUMINIUM–ZINC]
Pierre Lesbats 1967 74 p refs In FRENCH
(TN-431) CFSTI: HC $3.00/MF $0.65

Electron microscopy studies were made of the formation and transformation of the polygonal structures in aluminum and aluminum–zinc alloys. Experiments dealing with growth controls of single crystals and the influence of the degree of transformation upon joint migration in the structure are reported. Evolution of the polygonal structure by thermal cycling is studied, as is the existence of a critical temperature and its influence on the purity of the aluminum. Transl. by M.W.R.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-28981# Florida Univ., Gainesville. Communication Sciences Lab.
UNDERWATER SPEECH COMMUNICATION
Harry Hollien, John Brandt, and Carl Thompson 1 Apr. 1967 22 p refs
(Contract Nonr-580(20))
(Rept.-3; AD-649869) CFSTI: HC $3.00/MF $0.65

The audibility threshold performance of the human ear submerged in water at ear depths of 12 and 35 feet was compared to its performance in air. Threshold SPLs at 125, 250, 500, 1000, 2000, 4000, and 8000 Hz from 5 male and 3 female divers wearing open circuit SCUBA equipment were obtained by the Bekesy technique. Differences between water and air conduction thresholds ranged from 18 dB SPL re 0.0002 microbar at 125 Hz to 56 dB at 8000 Hz. Water conduction thresholds ranged from between 58 and 74 dB SPL with maximum sensitivity around 500 Hz. Maximum sensitivity for air conduction thresholds was obtained at 2000 Hz. Slightly higher thresholds were obtained at the 35 foot depth than at the 12 foot depth (about 1 dB at 250 Hz and 10 dB at 8000 Hz). Threshold SPL for male divers tended to be lower than female divers below 1000 Hz but higher than female divers above 8000 Hz in both air and water. Tentatively data suggest the importance of bone conduction mechanisms in underwater hearing. Author (TAB)

N67-28993# Mitre Corp., Bedford, Mass.
ERROR STATISTICS OF A MULTIPLE LINK DATA TRANSMISSION CIRCUIT
Kenneth Brayer Feb. 1967 26 p
(Contract AF 19(628)-5165)
(MTP-40; ESD-TR-66-337; AD-649758) CFSTI: HC $3.00/MF $0.65

Error patterns were measured on a combined troposcatter, microwave, wireline circuit of more than 6000 circuit miles. The error data consists of more than 6 x 10 to the 8th power transmitted bits at rates of 1200 and 2400 bits/sec. These error patterns are presented in a form suitable for the analysis of error control, modem improvements or channel modeling. Author (TAB)

N67-29023*# National Aeronautics and Space Administration, Washington, D. C.
RECEIVING ANTENNA OF THE WEIGHTLESSNESS LABORATORY [ANTENNE DE RECEPTION DU LABORATOIRE D'IMPESANTEUR]
Guy Ringenbach Jun. 1967 14 p refs Transl. into ENGLISH of ONERA-TP-374, 1966 Presented at the 12th Symp. of the AGARD Electron. Group, Duesseldorf, 7–13 Jul. 1966
(NASA-TT-F-11076; ONERA-TP-374) CSCL 09F

The O.N.E.R.A. uses the conditions of freefall of a body to obtain weightlessness conditions or zero acceleration conditions. The drop is carried out over an altitude of about 40 meters, inside a metallic tube which attenuates the telemetry waves and opposes their propagation. The present report is concerned with the utilization of a surface wave guide for picking up the signal and guiding it along the interior of the tube to the receiver. The average stationary wave intensity received is lower than 2% and the telemetry signals can be exploited during the entire drop. Author

N67-29064# Brown Univ., Providence, R. I. Div. of Engineering.
THE SCATTERING OF ELECTROMAGNETIC WAVES BY A FINITE WEDGE
Vincent James Aidala and D. M. Bolle Dec. 1966 60 p refs
(Contract AF 19(628)-5846)
(SR-4; AFCRL-67-0009; AD-650319) CFSTI: HC $3.00/MF $0.65

The scattering of a plane electromagnetic wave by a perfectly conducting finite wedge and other cylindrical obstacles is solved for the case of symmetric excitation where the E field is

parallel to the cylinder axis. Eigenfunction expansions for the field components are found using Greens functions. Through the application of boundary conditions, the problem is reduced to the solution of an infinite set of simultaneous equations for the scattered field expansion coefficients. These equations are solved by numerical methods. In addition, a perturbation solution is obtained for the reentrant wedge when the wedge angle is small. Finally, back-scattering radar cross-sections are calculated for various wedge angles and presented in the form of graphs. TAB

N67-29061# Istituto Universitario Navale, Naples (Italy).
RADIO LINKS AND ANTENNAS IN BOUNDLESS OR BOUNDED LOSSY MEDIA Final Report
Eugenio Corti, Giorgio Franceschetti, and Gaetano Latmiral 30 Jan. 1967 119 p refs
(Contract AF 61(052)-851)
(AFCRL-67-0187; AD-650719) CFSTI: HC $3.00/MF $0.65

The report is divided into three parts. The first part deals with the definition of suitable simple, clear and distance invariant parameters, apt to describe the radiation and reception of electromagnetic fields into boundless or bounded lossy media, as well as with the computation of the radio link formula in various situations (e. g., the far, intermediate and near field range in sub-surface or underwater propagation). The second part deals with the computation of the above parameters for linear electric bare antennas with a sinusoidal current distribution of complex argument. The above parameters are referred under several graphs. The most interesting result is that the efficiency of a bare antenna may reach relatively high values (e.g. from 20% up to 40%), provided that the length of the antenna is of the order of the wavelength into the lossy medium. The third part deals with a new type of antenna, particularly suitable for applications in lossy media, and realized by means of two closely spaced parallel plates, whose gap is filled by an insulator. The plates act as current collectors. Some preliminary experiment on model and real parallel plate antennas are referred. Author (TAB)

N67-29079# Navy Electronics Lab., San Diego, Calif.
A NUMERICAL ANALYSIS OF HF EXTENDED-SECTOR GROUND SYSTEMS
J. M. Horn 19 Jan. 1967 54 p refs
(NEL-1430; AD-650328) CFSTI: HC $3.00/MF $0.65

In an effort to determine shore antenna requirements, enhanced, low-angle, vertically polarized radiation was studied by greatly extended ground planes, and a numerical analysis conducted. It was found that (1) the modified radial ground system is superior to mesh ground systems; and (2) the results should be applied to individual designs on a cost effectiveness basis. Author (TAB)

N67-29124# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
ELECTROMAGNETIC INTERFERENCE MEASUREMENT METHODS—SHIELDED ENCLOSURE Quarterly Report, 1 Sep.–30 Nov. 1966
William R. Free, Charlton H. Bonham, Robert E. Gibson, John H. Gutzke, and Bernard M. Jenkins Apr. 1967 41 p
(Contract DA-28-043-AMC-02381(E))
(ECOM-02381-2; QR-2; AD-650830) CFSTI: HC $3.00/MF $0.65

During the period covered by this report, investigations of techniques and procedures for making radiation measurements in shielded enclosures which can be correlated with open-field measurements have continued. The primary objective of this program is to develop a capability for determining the case radiation and susceptibility characteristics of U. S. Army communication equipments in the controlled environments of shielded enclosures. A microwave hooded antenna capable of making the desired measurements in a shielded enclosure over the frequency range from 1 to 12 GHz has been developed and evaluated. Techniques for calibrating this probe antenna have been investigated during this period and are described in detail. A UHF hooded antenna, for use over the frequency range from 200 to 1500 MHz, has also been developed. The evaluation of this probe antenna has continued during this period and the results obtained to date are presented. Theoretical and experimental investigations of the field distribution within a shielded enclosure at low frequencies are discussed. Author (TAB)

N67-29131# RAND Corp., Santa Monica, Calif.
ECONOMICAL METHODS FOR CALCULATING LF AND VLF IONOSPHERIC ATTENUATION BASED ON WAVE THEORY
C. M. Crain and H. G. Booker Mar. 1967 23 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5296-PR; AD-650819) CFSTI: HC $3.00/MF $0.65

A companion Memorandum to RM-5248-PR, AD-650 818 LF and VLF Reflection Loss in the Lower Ionosphere: A Theorem on Absorption and Its Application, demonstrating the usefulness of its methods. An analysis is made of a National Bureau of Standards publication in which L. A. Berry compared different methods of calculating the transmission loss caused by nuclear detonation, including the 1964 Crain and Booker method (RM-4031). The cases used in Berrys comparison were recalculated by the improved Booker-Crain method of RM-5249, in which an empirical constant was refined, and an alternative procedure from the same Memorandum was used to check the results. For profiles usually encountered in a nuclear environment the methods are reliable and economical, but care should be taken in applying them to profiles that are not basically exponential in character. Author (TAB)

N67-29162*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATIONS SYSTEMS RESEARCH
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 271–319 refs (See N67-29141 18-34)

Continued research in telecommunication is reported. In block coding and synchronization studies, emphasis was placed on subcarrier tracking methods and communication system design, and on power allocation and noisy reference losses in phase coherent communication system. The number of information bits in cyclic codes, an algorithm for Marsh's cubic transformation, and the enumerative equivalence of group elements are discussed with respect to combinatorial communications. Aspects of information processing investigated include arithmetic decoding of cyclic codes, decoding codes beyond the Bose–Chaudhuri bound, and signal and noise in nonlinear devices. The use of six and eight quantiles to test hypothesis in data compressed experiments is described. A method for extracting the reflectivity distribution from planetary radar data is presented. N.E.N.

N67-29163*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT TELEMETRY AND COMMAND
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 320–325 refs (See N67-29141 18-34)

The design and development of a photon actuated, solid state switch is described. The switch includes an n-p-n planar silicon detector with an epitaxial base, and a GaAs diode for the photon emission. Initial radiation and life tests on the diode–transistor pairs are reported. N.E.N.

N67-29164*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT RADIO
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 327–338 refs (See N67-29141 18-34)

Modifications and investigations in radio equipment for telecommunications are described. The measurements of the effect on overall Mariner S-band turnaround ranging transponder

performance of environmental variations on each module are outlined. The quality of spacecraft guidance radar output data is shown to be affected by the radar beam configuration, and the criteria of quality, depending on altitude marking accuracy, slant range estimation bias, and variances of velocity and range estimates are discussed. Experimental apparatus and results of multipacting in coaxial transmission lines at S-band are outlined and the data is tabulated. The design and initial test results are briefly reviewed for high impact antenna consisting of an aluminim rectangular cup radiator. N.E.N.

N67-29238# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab. Div.

RESEARCH ON COMPACT AND EFFICIENT ANTENNAS

Interim Report, 1 Apr.–30 Sep. 1966

J. F. Ramsay and B. V. Popovich Nov. 1966 171 p refs

(Contract DA-28-043-AMC-02111(E))

(AIL-1748-I-1; Rept.-1; ECOM-02111-1; AD-650104) CFSTI: HC $3.00/MF $0.65

The research described is directed toward improving tactical communications antennas in the HF band. To facilitate the experimentation, modeling was done using scaled ground and scaled antennas. A carbon-loaded polyurethane elastomer was used to simulate dry ground. Although of finite size, the scaled ground sample used with various model antennas yielded elevation pattern data in substantial agreement with theory and permitted comparisons between different ground systems associated with the antennas. Water was also used as a simulating medium and permitted measurements to be made of surface waves and of the distribution of fields in different underground polarizations. A case is made for the adoption of standard grounds--dry, average, and wet--based on empirical quadratic relationship between dielectric constant and conductivity discovered by Albrecht. Tables and graphs of the reflection coefficients of dry and wet Albrecht grounds are given. Current work examines input impedance and ground-wave field attenuation characteristics using model antennas over model ground at microwave frequencies. The need for ground-wave test facilities in the HF band using a synthetic ground is pointed out. To this end research is required to relate the near-in ground wave to antenna efficiency. A measurable local figure of merit for a compact antenna is sought at an applicable range. Author (TAB)

N67-29281 Advisory Group for Aerospace Research and Development, Paris (France).

SPREAD F AND ITS EFFECTS UPON RADIOWAVE PROPAGATION AND COMMUNICATION

P. Newman, ed. (AFCRL) Maidenhead, England, Technivision, 1966 644 p refs

(AGARDograph-95)

A compilation of articles in presented on irregularities in the F region, production mechanisms of such irregularities and their movements, and on scintillation and radio wave propagation. For individual titles, see N67-29282 through N67-29318.

N67-29282 Advisory Group for Aerospace Research and Development, Paris (France).

A SURVEY OF EQUATORIAL SPREAD F

B. R. Clemesha and R. W. H. Wright *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 3–27 refs Sponsored by AFCRL (See N67-29281 16-07)

The methods of observation of spread-F irregularities are described and stress is laid upon the need for more specific experiments aimed at investigating particular spread-F aspects. Geomorphology and diurnal, seasonal, and sunspot cycle variations are outlined and discussed in relation to other ionospheric parameters. The properties of irregularities which have been determined so far are described, including their height of occurrence, motion, distribution and lifetime. A brief account is given of the mechanisms which have been suggested as responsible for spread-F echoes as seen on ionograms, and of current theories for the origin of irregularities; the properties of irregularities are discussed in this context. In conclusion, the directions in which further work should be carried out are outlined. Author

N67-29283 Advisory Group for Aerospace Research and Development, Paris (France).

SPREAD F IN THE PACIFIC

J. B. Lomax *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 29–58 refs (See N67-29281 16-07)

The unusually intense and widespread occurrence of spread-F in the mid-Pacific area on October 27, 1962 is described, as observed on both vertical- and oblique-incidence ionospheric sounders. A synchronized network of three transmitters and six receivers were operated during 1962 as oblique ionospheric sounders in the frequency range 4 to 64 Mc/s. A total of 17 oblique paths was employed in an area centered on the magnetic equator at 173° west longitude with a diameter of approximately 6000 km. Twelve vertical-incidence ionosondes were also operated in this area. Equatorial spread-F was first observed at 0600 G.M.T. During the following two hours, spread-F developed progressively from east to west and extended north and south to dip angles of 35°. Only one of the 17 oblique paths and three of the vertical ionosondes (at 38° to 40° dip angles) definitely did not exhibit spread-F. Effects were observed over a period of eleven hours, lasting until local sunrise the following morning. The onset and development of spread-F is illustrated with ionograms from the various observing stations. Author

N67-29284 Advisory Group for Aerospace Research and Development, Paris (France).

OBSERVATIONS OF EQUATORIAL SPREAD F AT DJIBOUTI AND DAKAR [OBSERVATION DU F DIFFUS EQUATORIAL A DJIBOUTI ET A DAKAR]

P. Halley and B. Gatty *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 59–65 refs In FRENCH (See N67-29281 16-07)

Echo displays of zenith probes in the F region were studied from hourly measurements made daily at the Djibouti and Dakar stations near the magnetic equator. The importance of hourly and seasonal variations were considered, as well a weak variation in solar activity that was noted. Principal characteristics of spread-F were studied. Transl. by M.W.R.

N67-29285 Advisory Group for Aerospace Research and Development, Paris (France).

PRELIMINARY RESULTS ON MID AND HIGH LATITUDE TOPSIDE SPREAD F

L. E. Petrie *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 67–77 refs (See N67-29281 16-07)

The topside sounder in the Alouette satellite provides information for the study of irregularities in the ionosphere. An investigation of spread echoes at mid- and high-latitudes in the Northern Hemisphere is described. During the daytime the ionograms recorded north of a geomagnetic latitude of about 55°N usually exhibit spread echoes, while those recorded south of this latitude exhibit no spread echoes. The percentage occurrence of spread echoes at all frequencies on the extraordinary wave trace exhibits diurnal, seasonal, and latitudinal variations similar to those of the scintillation index used in satellite and radio star scintillation studies. The diurnal and latitudinal variations of the strong spread echoes at the satellite height are similar to those of sporadic E, visual aurora, radio blackouts, and horizontal deviations of the earth's magnetic field. Author

N67-29286 Advisory Group for Aerospace Research and Development, Paris (France).
TOPSIDE SPREAD F AND FIELD-ALIGNED STRUCTURE
P. Vila *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 79–87 refs (See N67-29281 16-07)

The field-aligned structure of ionization associated with the boundaries of spread-F at middle latitudes can be directly studied by the combining topside and fast sweeping ground based ionograms. A few examples are interpreted by partial ducting of the probing wave. An estimate is given for the corresponding scales of the field-aligned structures. Author

N67-29287 Advisory Group for Aerospace Research and Development, Paris (France).
THE ANGULAR SPREAD OF SPREAD-F ECHOES
J. Reway and W. A. Flood *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 89–101 refs (See N67-29281 16-07)
(Contract AF 19(628)-351)

A 10kW pulsed transmitter operating at 2.4 Mc/s was used to irradiate the ionosphere. When the A-scope scan differed markedly from that corresponding to normal ionospheric conditions, the input was recorded. The backscattered echoes were received on three half-wave dipole antennas. Set on a linear path, each antenna was separated from the other by four wavelengths, and the detected outputs of the receivers were tape recorded on three separate channels. A limited sample of fifteen spread-F cases was recorded and analyzed. Although the instrumentation did not allow the determination of the mean angle of arrival of the backscattered signals, cross correlation of the received signals permitted an estimate of the minimum angular spread (cone angle of arrival) of the received echoes. When ionospheric conditions are such that spread-F is present, the angular spread of the backscattered signals is found to be much larger than the angular width associated with normal *F* region returns. Author

N67-29288 Advisory Group for Aerospace Research and Development, Paris (France).
THE INFLUENCE OF FOCUSING UPON THE APPARENT REFLECTION COEFFICIENT OF THE F REGION
L. E. Petrie, E. L. Hagg, and E. S. Warren *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 103–120 refs (See N67-29281 16-07)

The apparent reflection coefficients of the ionosphere for high frequency radio waves were studied using vertical incidence pulse amplitude data obtained at Prince Rupert. The F layer first hop reflection coefficient increases in magnitude as the degree of spread-F increases. This increase in magnitude can be explained by focusing of the energy scattered from an irregular surface or by propagation of the energy along field aligned ducts. Revised methods for obtaining calibration constants for ionospheric absorption measurements are required. Author

N67-29289 Advisory Group for Aerospace Research and Development, Paris (France).
A NOTE ON HIGH-LATITUDE SPREAD F
J. Frihagen and K. Folkestad *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 121–126 refs (See N67-29281 16-07)
(Contract AF (052)-610)

Results of an analysis of data from oblique incidence soundings during spread-F conditions are presented. Some comments have been made on the fading characteristics of spread-F reflections. Author

N67-29290 Advisory Group for Aerospace Research and Development, Paris (France).
SOME CHARACTERISTICS OF SPREAD F IN VERY HIGH LATITUDES
J. K. Olesen and S. B. Jepsen *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 127–138 refs (See N67-29281 16-07)

The study is based upon ionograms and f-plots for eight months from Narsarssuaq, Godhavn, and Thule in Greenland. To describe the variations, (diurnal, annual, latitudinal, and through the sunspot cycle), a measure for the intensity of spread-F has been used. The results are to a great extent in agreement with those of earlier investigations concerning the occurrence frequency of spread-F, apart from some deviations which need further examination before definite conclusions can be drawn concerning their significance. Author

N67-29291 Advisory Group for Aerospace Research and Development, Paris (France).
FREQUENCY OF SPREAD-F OCCURRENCE OVER ANTARCTICA
R. Penndorf *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 137–166 refs Prepared for NSF (See N67-29281 16-07)

Frequency of occurrence of spread-F in the Antarctic during the IGY period was compared with data for the Arctic. While conditions in the two polar regions seem to differ in some respects, the basic features are very similar. The area around the magnetic poles experiences the highest frequency of spread-F occurrences, at least 60%, with no appreciable diurnal variation during the winter. This permanent maximum, centered over Wilkes Land inside the auroral zone, shows very little change with season. Over the polar cap no diurnal variation is experienced during the winter; however, at the auroral zone and outside of it, a diurnal variation is noticed. During the summer and equinoxes, all stations undergo diurnal variations although those situated in the permanent maximum experience a diurnal variation of only 30%. A travelling maximum, moving along the midnight meridian at the auroral zone and through the dip pole area is established by the synoptic-map technique. The inner Antarctic seems to experience more spread-F than the conjugate area in the Arctic. Author

N67-29292 Advisory Group for Aerospace Research and Development, Paris (France).
THE APPLICATION OF THE PARTIAL CORRELATION ANALYSES TO THE STUDY OF THE OCCURRENCE PROBABILITY OF SPREAD F
Tatsuo Shimazaki *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 167–188 refs (See N67-29281 16-07)

Several ionospheric parameters have been considered as possible factors which control the occurrence of spread-F, and the correlation coefficients between each parameter and the occurrence probability of spread-F have been examined. However, each of these correlations has ignored the effect of other parameters. Before examining the correlation between each parameter and the spread-F occurrence probability the effect of other factors should be eliminated systematically. The technique of partial correlation is useful for this purpose. In this study the partial correlation coefficients between various ionospheric, solar, and geomagnetic parameters and the spread-F occurrence probability are studied for Washington and Wakkanai. The results show that the partial correlation analyses give better and more reasonable results than the simple ones in many respects. Author

N67-29293 Advisory Group for Aerospace Research and Development, Paris (France).
SPREAD F AND GEOMAGNETIC ACTIVITY IN MIDDLE LATITUDE
M. Anastassides, D. Ilias, and G. Moraitis *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 189–204 refs Sponsored by AFCRL (See N67-29281 16-07)

Spread-F data collected between 1961 and 1963 and scintillation data for 1962 and 1963 are analyzed statistically. The spread-F occurrence has maxima around the solstices; the secondary maximum occurs in summer. The diurnal variation shows a maximum after midnight. A negative correlation exists between spread F and geomagnetic activity in summer and a positive one in winter. Athens belongs to the equatorial belt spread F during summer but in winter it is situated north of this belt. Author

N67-29294 Advisory Group for Aerospace Research and Development, Paris (France).
RELATIONS BETWEEN NIGHT-TIME LUMINOSITY AND THE PRESENCE OF SPORADIC E AND SPREAD F [RELATIONS ENTRE LA LUMINESCENCE NOCTURNE ET LA PRESENCE DE COUCHES E SPORADIQUE ET F DIFFUS]
A. Vassy and J. C. Jeannet *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 205–211 refs In FRENCH (See N67-29281 16-07)

A series of nightglow measurements were made at Hammaguir in Feburary 1961 and October 1962, and at Valensole during each new moon period since September 1963. The celestial isophote permitted the altitude determination of the emitting layer. If this is irregular, it indicates the presence of perturbations which can be located. Of these, the presence of sporadic E layer and the F-spread is noted. The brilliance is more than double the current value. The red and green lines do not show the same phenomenon. Transl. by R.U.

N67-29295 Advisory Group for Aerospace Research and Development, Paris (France).
F-REGION IRREGULARITIES STUDIED BY SCINTILLATION OF SIGNALS
K. C. Yeh and G. W. Swenson, Jr. *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 217–246 refs (See N67-29281 16-07)
(Grant NsG-24-59)

Scintillation of radio signals from earth satellites has been studied for five years during the declining phase of the sunspot cycle. It is found that the character of the scintillation, and thus, probably, of the ionospheric irregularities that cause them, vary systematically with geomagnetic latitude, season of the year, time of day, and phase of the sunspot cycle. Night-time scintillation occurs in the F region, mainly at heights of about 350 km. This type of scintillation in most cases results from first-order scattering from weak, field-aligned irregularities in electron density, which may be caused by two-stream instabilities excited by "dumping" of electrons from the earth's radiation belts. Such scintillations are observed north of a certain parallel of geomagnetic latitude, the southern limit varying weakly with magnetic activity. Similar effects are observed in both Northern and Southern Hemispheres. Author

N67-29300 Advisory Group for Aerospace Research and Development, Paris (France).
SOME STUDIES OF NIGHT-TIME F-LAYER IRREGULARITIES AT THE EQUATOR USING VERY HIGH FREQUENCY SIGNALS RADIATED FROM EARTH SATELLITES
G. S. Kent and J. R. Koster *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 333–356 refs (See N67-29281 16-07)

This report describes some investigations made in Ghana, during 1962 and 1963, into the nature of the night-time irregularities responsible for scintillation of radio signals received from radio stars and earth satellites. The method used has been to study the diffraction patterns formed on the ground by such waves after they have passed through the ionosphere. Signals were received on three spaced aerials. Numerical methods of correlation analysis, more powerful than the usual graphical methods, have been developed to analyse fading of these signals. It is found that the irregularities are highly elongated with axial ratios of the order of 20:1 and are aligned along the earth's magnetic field lines. Estimates of their height show that the irregularities occur in a layer about 100 kilometers thick at approximately 300 kilometers above the earth. Author

N67-29301 Advisory Group for Aerospace Research and Development, Paris (France).
THE DIFFRACTION OF HF RADIO WAVES BY IONOSPHERIC IRREGULARITIES
J. P. Debarber and W. J. Ross *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 357–371 refs (See N67-29281 16-07)
(Grant NsG-114-61; Contract AF 33(616)-6157)

The statistical parameters of the diffraction of radio waves from a thin screen of irregularities illuminated at oblique incidence are discussed and are related to the properties of an ionospheric diffracting layer containing field-aligned inhomogeneities. The methods are applied to measured amplitude diffraction patterns of a 54 Mc/s satellite beacon signal made with spaced receivers at a mid-latitude station. The causative ionospheric irregularities are found to occur at heights ranging from 300–600 km, but often concentrated in a relatively thin layer of thickness 50 km or less on a particular occasion. They are field aligned to better than 5° along their major axes and, in the case of smaller sized irregularities of about 1 km lateral dimension, have an axial ratio of 10 or greater. Author

N67-29302 Advisory Group for Aerospace Research and Development, Paris (France).
OBSERVATIONS OF IONOSPHERIC SCINTILLATIONS BY VHF RADAR REFLECTIONS FROM EARTH'S SATELLITES
G. H. Millman and A. J. Moceyunas *In its* Spread F and its Effects upon Radiowave Propagation and Commun. 1966 p 373–381 refs (See N67-29281 16-07)
(Contract AF 30(602)-2244)

Radar reflections from artificial earth satellites tracked at a frequency of 425 Mc/s have at times revealed unusual amplitude scintillations in certain spatial regions of the orbital trajectories. The experimental observations were conducted at the U.S. Air Force Trinidad Test Site, West Indies (22° geomagnetic north latitude), during 1961. An analysis of the scintillation data has indicated that the perturbations were most likely caused by the presence of ionospheric irregularities along the radar-satellite transmission paths. An estimate is made of the possible extent of the irregularities. The scintillations appeared only during the nighttime and when the antenna beam was oriented in a southerly direction toward the equatorial ionosphere. The correlation of the experimental data with solar-geophysical condition existing during the time of the radar measurements is also presented. Author

N67-29303 Advisory Group for Aerospace Research and Development, Paris (France).
THE SCINTILLATION OF RADIO SIGNALS FROM THE DISCOVERER 36 SATELLITE
W. J. G. Beynon and E. S. O. Jones *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 383–394 refs (See N67-29281 16-07)

The results of measurements on "scintillation" observed on 20 Mc/s radio signals from satellite Discoverer 36 are presented. The observations cover geomagnetic latitudes 44° to 67°N and show a steady increase in the scintillation intensity with latitude. A sharp increase in scintillation intensity occurs at a latitude a few degrees to the equatorward side of the auroral zone. There is a close correspondence between the incidence of scintillation and spread F and it is concluded that the same irregularities in the F layer (above about 250 km) are responsible for the two phenomena. Data are presented on the diurnal variation in the lower latitude limit of scintillation and its variation with magnetic activity. Author

N67-29304 Advisory Group for Aerospace Research and Development, Paris (France).

A STUDY OF THE OCCURRENCE OF SATELLITE SCINTILLATION OBSERVED IN THE AURORAL ZONE

L. Liszka *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 395–408 refs (See N67-29281 16-07)

(Contracts AF 61(052)-601; AF 61(052)-678)

Studies of the occurrence of satellite scintillation observed at Kiruna Geophysical Observatory have shown that the scintillation phenomenon depends both on the time of observation and on magnetic activity. The shape of this dependence may be explained by assuming diurnal changes in the scintillation rate spectrum. The geographical distribution of scintillation activity above northern Scandinavia was also studied. The apparent agreement obtained between contours of constant scintillation activity and lines L = const. may be interpreted in terms of a connection between the scintillation phenomenon and the radiation belt. An attempt was also made to investigate the northern extent of the scintillation phenomenon. Author

N67-29307 Advisory Group for Aerospace Research and Development, Paris (France).

THE EFFECT OF SPREAD F ON THE PROPAGATION OF RADIOWAVES NEAR THE EQUATOR

K. Davies and A. F. Barghausen *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 437–466 refs (See N67-29281 16-07)

A phenomonological description is given of certain aspects of high-frequency radio propagation studies, via the ionosphere, in Africa. Using the ionosonde technique with oblique propagation and a frequency measuring technique the following phenomena were studied, primarily from an engineering viewpoint: (a) F scatter, (b) flutter fading, (c) accuracy of MUF calculations. The measurements were carried out at two epochs of the sunspot cycle. Author

N67-29308 Advisory Group for Aerospace Research and Development, Paris (France).

OBLIQUE SOUNDING OF A TRANSEQUATORIAL PATH

D. Nielson *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 467–492 refs (See N67-29281 16-07)

Oblique propagation in the vicinity of the magnetic equator is discussed, with emphasis on the evening and nocturnal hours. Like equatorial spread-F, anomalous modes of propagation were observed to begin shortly after sunset and usually to persist throughout the night. Frequencies in excess of 64 Mc/s were frequently propagated, in spite of a path length of 4800 km. Other transequatorial paths in the same vicinity are reviewed briefly in a comparative analysis of the aspect sensitivity of the equatorial irregularities responsible for this VHF mode. Its usefulness to communication circuits is also explored. Comparisons are made between records from a vertical-incidence sounder and those from three oblique-incidence ionosondes in the same vicinity. Correlation between spread conditions on each is shown. Distinction is made between oblique spread echoes due to E-layer irregularities and those due to F-layer irregularities. Ray tracings for measured profiles are shown for transequatorial paths. Author

N67-29309 Advisory Group for Aerospace Research and Development, Paris (France).

TRAVELLING WAVES IN THE F REGION OVER ARECIBO ASSOCIATED WITH A MAGNETIC DISTURBANCE

G. D. Thome and W. E. Gordon *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 495–504 refs (See N67-29281 16-07)

(Contract AF 49(638-1156)

The existence of two different types of spread-F phenomena at the equator was shown in an ionospheric moving picture film. The F type, having a resemblance to the equatorial E_s, is assumed to be generated by small scale turbulence starting at the bottom of the F layer and at the height of maximum electron density. The V type corresponds to vertical sheets in which ionization is decreased by localized upward drift of the ionization. The necessity to separate both phenomena in future investigations of equatorial spread F can be demonstrated. Clear periods of four or five hours have been found in the variation of F-region ionization at the equator. The seasonal change of their mean amplitude is surprising. At the equator, correlations of ionization variations exist up to 3000 km distance; this is almost impossible at temperature latitudes. There are some indications that the large scale oscillatory movement corresponds more to a standing wave than to a travelling wave. Author

N67-29310 Advisory Group for Aerospace Research and Development, Paris (France).

SEASONAL DEPENDENCE OF MOVEMENT AND TURBULENCE PHENOMENA IN EQUATORIAL F-LAYER IONIZATION

K. Bibl *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 505–516 refs (See N67-29281 16-07)

(Contract AF 61(052)-623)

The ionospheric backscatter technique is used to study intense fluctuations observed above Arecibo during geomagnetically disturbed conditions. The ionosphere between 100 and 600 kilometers is examined over a 17-hour period. The fluctuations clearly exhibit the characteristics of a wave traveling from east to west at about 150 meter sec. The wave period is of the order of two hours and the corresponding wavelength is therefore about 1000 kilometers. The disturbance extends throughout the F region with appreciable amplitude above and below the layer maximum. The observed fluctuations of electron density at a given height appear to be caused primarily by vertical motion of the layer as a whole, rather than by a mechanism such as compression and rarefaction. The vertical displacement at the layer maximum is found to be 40 kilometers. Author

N67-29311 Advisory Group for Aerospace Research and Development, Paris (France).

STUDY OF IONOSPHERIC IRREGULARITIES AND RELATED PHENOMENA IN THE F REGION

R. N. Singh *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 517–525 refs (See N67-29281 16-07)

Observations of ionospheric irregularities in the F region during the night hours were made at Benares (Geomag. lat. 25.31°N, Geomag. long. 83°E) for the years 1958–60. Three spaced-receiver fading records are grouped into two classes: first, giving rise to the velocity in the line of sight, and second, characteristics of irregularities present in the F region. Analyzing these records, the size of the irregularities and the spread of the incident wave scattered from them are found. The consequence of the moving anisometric irregularities is investigated. Assuming, that the isometric irregularities in their motion are deformed into a characteristic ellipse, the records are analyzed by modified cross-correlation analysis to evaluate the axial ratio and the orientation of the characteristic ellipse. Using these parameters, the true velocity and the true direction of the moving irregularities are determined. The effects of the magnetic disturbance on the nature of the irregularities in the F region are discussed. The simultaneous occurrence of the spread-F and ionospheric irregularities are described. The presence of sporadic E does not affect the fading pattern except for a weak and random superimposition on the amplitude of the pattern. Evidence of field alignment of irregularities in the F region was found and is discussed. Author

N67-29315 Advisory Group for Aerospace Research and Development, Paris (France).
THE PRODUCTION OF SPREAD-F IRREGULARITIES
D. G. Singleton *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 553–565 refs (See N67-29281 16-07)

The main properties of the irregularities responsible for spread-F are briefly reviewed. The current theories of irregularity production are critically discussed in terms of these properties. It is found impossible to reconcile the experimental results with four of these theories, namely, Martyn's instability of the under surface of an upward drifting layer, Dagg's E-region turbulence communicated to the F layer, Axford and Hines convective motion of the magnetosphere, and a theory of auroral particle origin of the irregularities. A further theory, based on initiation of instability of the surface of as drifting layer by hydromagnetic waves, is proposed. It is shown that this theory is in accord with the experimental findings. Author

N67-29316 Advisory Group for Aerospace Research and Development, Paris (France).
A CHARGED PARTICLE PRODUCTION MECHANISM FOR SPREAD-F IRREGULARITIES
J. R. Herman *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 567–578 refs (See N67-29281 16-07)
(Contract AF 19(628)-2788; Grant NSF C-255)

The assumption is made that field-aligned irregularities are caused by low energy (< 20 KeV) charged particles spiralling along magnetic field lines and penetrating to F-region heights. Ionization is created along the field lines by collisions, and it remains field-aligned owing to the effects of diffusion. It is suggested that this mechanism is operative at all times but with some variation in intensity. During daytime the irregularities produced in this manner are usually masked by higher electron densities created by photoionization. Supporting evidence for the proposed production mechanism is given by the diurnal, seasonal, and geographical variations in spread-F occurrence, and its correlation with magnetic activity. Author

N67-29317 Advisory Group for Aerospace Research and Development, Paris (France).
ORIGIN OF FIELD-ALIGNED IRREGULARITIES IN THE F2 LAYER
S. A. Bowhill *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 579–590 refs (See N67-29281 16-07)
(Grant NSF GP-868)

The possibility is investigated that field-aligned irregularities may be an effect of an increased electron temperature in the F-2 layer. Thermal conduction perpendicular to the magnetic field of the earth is sufficiently small that these inhomogenities of electron temperature could be expected to maintain themselves for a considerable period. The heat production and loss mechanisms that could apply are investigated in detail. Various experiments are suggested which could determine the possible importance of this effect. Author

N67-29318 Advisory Group for Aerospace Research and Development, Paris (France).
F-REGION IRREGULARITIES AFTER HIGH ALTITUDE DETONATION OF JULY 9, 1962
P. Newman, B. Jones, and L. McCabe *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 591–601 refs (See N67-29281 16-07)

The high altitude detonation at Johnston Island was followed by strong ionospheric effects. Ionograms taken at Palmyra Island show formation of a transitory F-1, and pronounced changes in F-layer critical frequency and height. Intense spread-F occurred whose initial stages had a higher than usual frequency spreading component. Most stations showed early enhancement of the F critical frequency, followed by a decrease to a level generally below normal. Heaviest spread-F appeared to be at stations where energetic particle input was heavy. Author

N67-29380*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ATMOSPHERIC TRANSMISSION OF INFRARED RADIATION FROM 2–5 MICRONS FOR SLANT PATHS FROM 35,000 FEET TO THE UPPER LIMIT OF THE ATMOSPHERE, A SURVEY
Herbert L. Richards, comp. Washington, NASA, Jun. 1967 15 p refs
(NASA-TN-D-4008) CFSTI: HC $3.00/MF $0.65 CSCL 17E

Atmospheric transmission of infrared radiation along slant paths are presented for altitudes between 35,000 feet and the upper limit of the atmosphere. Solar spectra were examined in regions within the various transmission bands. A single curve represents a composite transmission spectrum or the average values of five researchers for a zenith angle of approximately 60° and an altitude of 35,000 feet from 2.0 to 4.5 microns. Little data were available beyond 4.5 microns, but there was indication that transmission was greater than 90% up to 4.9 microns at 17,000 feet. M.W.R.

N67-29423# Naval Ordnance Lab., Corona, Calif.
PROPAGATION AND REFLECTION OF MICROWAVES Quarterly Progress Report, Period Ending 31 Dec. 1966
D. L. Thompson 15 Mar. 1967 13 p
(IED-G5; AD-651202) CFSTI: HC $3.00/MF $0.65

Work continues on analysis of anomalies noted in the behavior of microwave signals reflected bistatically from a complex mountain terrain target. Improvements are being made on the single-sideband boomerang (a portable device for optimizing the focus adjustment of the equipment used in the project) in order to permit short-range simulation of multifacet targets. Antenna feed systems and ancillary RF equipment for the 2.4 GHz region are being developed. Author (TAB)

N67-29489# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANTENNAS
G. B. Belotserkovskiy 7 Dec. 1966 656 p refs Transl. into ENGLISH of the book "Antenny" Moscow, Oborongiz, 1962 p 1–492
(FTD-HT-66-360; TT-67-61574; AD-650519) CFSTI: HC $3.00/MF $0.65

The book considers the theory of long lines, electromagnetic waves and radio wave propagation, antenna-feeder devices for various bandwidths, and antenna measurement engineering. The questions of the theory and design of antennas for the ultrashort wavelengths which are used in radar, radiocommunication, and television are considered in the greatest detail. This book is a text for the course 'Antennas' for the technicians in addition it will be useful for college students, engineers and technicians in industry. Author (TAB)

N67-29497# General Dynamics/Electronics, Rochester, N. Y.
A FREQUENCY-DIFFERENTIAL PHASE-SHIFT KEYED DIGITAL DATA MODEM FOR OPERATION AT 4800, 2400, 1200, AND 600 BITS PER SECOND OVER LONG-RANGE HF PATHS Final Report
Gene C. Porter, Martin B. Gray, and Charles E. Perkett Bedford, Mass., AFSC, Electron. Systems Div., Oct. 1966 72 p refs
(Contract AF 19(628)-5536)
(ESD-TR-66-639; AD-650726) CFSTI: HC $3.00/MF $0.65

The ANDEFT/SC-320 is a variable rate (4800, 2400, 1200 or 600 bits/second) digital data modem prototype specifically designed for reliable communication over long-range high-frequency radio circuits. This modem employs such advanced and proven techniques as frequency-differential phase-shift keying, correlation detection, extended symbol length, guard time, segmented AGC, and dual-mode precision synchronization to combat HF anomalies such as multipath delay spread, frequency selective fading, high intensity atmospheric noise and man-made interference. The modem has provision for dual signal source diversity operation to capitalize on available space, frequency, or polarization diversity facilities, and in addition, can be operated with in-band frequency diversity. The prototype is built in two separate cabinets (modulator and demodulator) to enable field testing and to allow for easy expansion to an ultimate data capacity of 9600 bits/second. This report presents the principles of operation of the modem and the results of tests to determine the back-to-back performance in additive white Gaussian noise. Author (TAB)

N67-29572# Advisory Group for Aerospace Research and Development, Paris (France).
ON THE STUDY OF THE AMPLITUDE OF THE RADIOELECTRIC COURSE OF A SATELLITE AT THE HORIZON OF THE STATION [SUR L'ETUDE DE L'AMPLITUDE DU CHAMP RADIOELECTRIQUE D'UN SATELLITE A L'HORIZON DE LA STATION]
J. F. Aurejac (Paris Univ.) and J. Papet-Lapine 1966 32 p In FRENCH; ENGLISH summary
(AGARD-553) CFSTI: HC $3.00/MF $0.65

Using a 40 Mc/s high gain aerial, which can be pointed in all directions of azimuth, the Val–Joyeux station can receive signals from Explorer 22 satellite for all revolutions from 330° to 206° of longitude W when passing over the equator. In extreme cases this represents a distance between the satellite and the observer which is sometimes more than 5,000 km. Because of a very long journey in the ionosphere, it is possible to show a considerable increase in the refraction effects and in the effect of irregularities in the distribution of the electron density in the environment traversed. Thus a large increase in scintillations is observed when the angle of elevation is approximately 20° or less. This increase in scintillations is particularly noticeable towards the north, but also towards the south. In the latter case some correlation between magnetic activity and the scintillation coefficients has been observed. A systematic comparision with the results obtained by other stations is then made to define the areas giving rise to such scintillations. Author

N67-29575# Naval Research Lab., Washington, D. C.
FREQUENCY CONTROL OF NAVY VLF STATIONS
R. R. Stone, *Jr. In its* Rept. of NRL Progr. Feb. 1967 p 8–16
(See N67-29573 16-34)

The Navy currently has six very-low-frequency transmitting stations that provide local reference for all Naval ships and stations. The most recent addition to this network is station NWC at North West Cape, Australia. These shore-based stations are synchronized in frequency with the master standard at the Naval Observatory to provide a world-wide reference system. Some of the transmissions provide the time of day in addition to the reference frequency. Five of these stations have been equipped with new phase-coherent keyers for transmission of frequency-shift-keyed signals. Author

N67-29580* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TELEMETRY DATA INTERPOLATION PROGRAM FOR OGO C&D EXPERIMENT 19 Users Manual
Barbara Walton May 1967 50 p
(NASA-TM-X-55800; X-565-67-246) CSCL 09F

Operating instructions are presented for the computer program to generate tabulations and plots of data obtained from the satellite and to correlate the telemetry data and the attitude and orbit data. The input, set-up and run, and output procedures are described, and flowcharts are included. N.E.N.

N67-29582# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
BROADBAND TRANSISTOR TECHNIQUES
W. Hatley and W. Doherty Apr. 1967 31 p refs
(Contract DA-28-043-AMC-01829(E))
(EDL-M1022; ECOM-01829-M1022; AD-649783) CFSTI: HC $3.00/MF $0.65

Three techniques for developing power levels in excess of 100-watts over wide bandwidths in the VHF frequency range were investigated: (1) direct amplification at power output, (2) generation of power at lower frequency and use of passive multipliers, and (3) use of active multiplying devices to provide both amplification and frequency multiplication. Third technique was most successful and an amplifier having 100-watt, at 100-MHz, with 20% bandwidth was constructed. However, limiting factor was impedance match at the input to the high power translator. Recommend efforts be directed to computer techniques to effect impedance match. TAB

N67-29583# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
LOG-PERIODIC ANTENNA TECHNIQUES
Louis G. Bullock, Claes T. Elfving, and Stuart K. Miller Apr. 1967 70 p refs
(Contract DA-28-043-AMC-01829(E))
(EDL-M1016; ECOM-01829-M1016; AD-649838) CFSTI: HC $3.00/MF $0.65

The report describes several investigations conducted during the past year in the area of log-periodic antennas. The work on inductively loaded, foreshortened log-periodic antennas included measurement of patterns and gains of antenna models which were foreshortened by various amounts. Capacitive top-loading of monopole antennas was also investigated to develop other techniques for log-periodic antenna foreshortening. Finally, a new, flat plate boom configuration for stronger and less expensive construction of log-periodic dipole array antennas is described. Author (TAB)

N67-29587# Naval Missile Center, Point Mugu, Calif. Systems Engineering Div.
MULTIPATH PROBLEMS IN RADIO FREQUENCY TRANSMISSION SYSTEMS
L. Hughes, L. Van Doren (Smyth Res. Associates), and W. D. Titus 27 Mar. 1967 54 p refs
(TM-67-9; AD-649844) CFSTI: HC $3.00/MF $0.65

The phase characteristics of incoherent multipath reflection between airborne and ground-based terminals was examined. Measurements were made on calm overwater paths at frequencies of 2.735 and 8.205 GHz. No significant differences in the measured phase spectra are noted for the two frequencies of measurement or with propagation direction relative to sea surface wave structure. The measured phase spectra decreases at a rate of 3 to 5 db per octave in the 100- to 1,000-Hz band. Maximum phase modulation indexes observed are 10 degrees rms phase deviation within the 100- to 2,000-Hz band. This phenomenon probably does not present an important limitation to data-link reliability. Author (TAB)

N67-29628# Sperry Rand Research Center, Sudbury, Mass.
PERFORMANCE EVALUATION OF SPEECH PROCESSING DEVICES. III. DIAGNOSTIC EVALUATION OF SPEECH INTELLIGIBILITY Final Scientific Report, 1 Mar. 1966–30 Nov. 1966

William D. Voiers Mar. 1967 77 p refs
(Contract AF 19(628)-4987)
(SRRC-CR-67-8; AFCRL-67-0101; AD-650158) CFSTI: HC $3.00/MF $0.65

The report summarizes the results of a program of research on communication system evaluation from the standpoint of speech intelligibility and speaker recognizability. The history and present status of the Diagnostic Rhyme Test (DRT) Form III are described along with the results of research relating to the validity of the DRT in various applications. Author (TAB)

N67-29653# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SEVENTY Gc PULSE RADAR
Cecil L. Wilson Nov. 1966 24 p
(BRL-TN-1637; AD-650318) CFSTI: HC $3.00/MF $0.65

The Ballistic Research Laboratories have obtained, and placed in operating condition at 70 Gc pulse radar system. This system has made possible many useful measurements of target comparison and background clutter which are being applied to target signature studies. The results of these measurements will be given in subsequent reports. This instrument is thought to be the only high power narrow pulse radar operating at 70 Gc in this country. A sufficiently large number of groups of persons have expressed an interest in using the radar that it appears to be worth while to prepare this technical note as a means of disseminating the descriptive information. This note should also serve as a record of the steps taken to place the radar in operation and as a service manual. TAB

N67-29669# Navy Underwater Sound Lab., New London, Conn.
SURFACE-TO-SURFACE AND SUBSURFACE-TO-AIR PROPAGATION OF ELECTROMAGNETIC WAVES: THE DERIVATION OF ELECTRIC AND MAGNETIC FIELD COMPONENTS FOR THE QUASI-STATIC, QUASI-NEAR, AND NEAR-FIELD RANGES
Peter R. Bannister 17 Feb. 1967 31 p refs
(USL-781; AD-649917) CFSTI: HC $3.00/MF $0.65

The electric and magnetic field components produced by vertical and horizontal dipoles (both electric and magnetic) are derived and presented for the quasi-static, quasi-near, and near-field ranges. The depth, h, of the transmitting dipole is less than or equal to zero; the height, z, of the receiving antenna above the plane, conducting, homogeneous earth varies from zero to some height, z, that is much less than the ionospheric reflecting height (ionospheric effects are neglected). The horizontal separation, rho, between th transmitting and receiving antennas is comparable to the receiving antenna height, z. The derivations are based upon the quasi-static and near-field approximations to the vector potentials for the vertical and horizontal dipoles and upon applications of the reciprocity theorem. The surface-to-surface propagation equations reduce to well-known expressions when the absolute value of gamma sub 1 rho >>1 and the absolute value of gamma sub 1 rho <<1, as do the subsurface-to-air equations when rho >>z. Author (TAB)

N67-29678# Little (Arthur D.), Inc., Cambridge, Mass.
A UNIFIED THEORY FOR OPTIMUM ARRAY PROCESSING
H. L. Van Trees Aug. 1966 82 p refs
(Contract NObsr-93055)
(Rept.-4160866; AD-649929) CFSTI: HC $3.00/MF $0.65

The primary purpose of the report was to fit various techniques and criteria related to optimum array processing into a unified theory. Since the models used were only approximations to the actual physical situation, it is important to understand how various assumptions affect the optimum receiver structure. For an interesting class of criteria and signal models it was found that the optimum receiver consisted of a set of delays to steer the array followed by a combining operation which depended only on the noise covariance matrix. The output of this combiner is a single waveform, which is then processed depending on the criterion and signal model. Author (TAB)

N67-29680# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF PROPAGATION OF VERY LONG WAVES [TEORIYA RASPROSTRANENIYA SVERKHDLINNYKH VOLN]
P. Ye. Krasnushkin and N. A. Yablochkin 16 Feb. 1967 112 p refs Transl. into ENGLISH of the book "Teoriya Rasprostransniya Sverkhdlinnykh Voln" Moscow, 1963 p 1-94
(FTD-MT-65-397; AD-650489) CFSTI: HC $3.00/MF $0.65

An attempt is made to match experimental and theoretical data on long-distance propagation of superlong (wave-lengths of several times ten kilometers) waves around the earth. Since there is no probability distribution function for the experimental data, the matching is carried out approximately by the method of mixed initial data, where all the data on the field and on the medium are divided into two groups—reliable and unreliable. Several models are proposed for the propagation along the earth's surface and in the ionosphere with an attempt to include all the geophysical factors which influence the far field of superlong radio waves. Only the waveguide channel adjacent to the earth is considered. The method of normal waves which can be used to solve waveguide propagation problems for sound waves in the ocean, infrasound waves in the atmosphere, seismic waves in the earth, etc., is also developed. Author (TAB)

N67-29685# Conductron Corp., Ann Arbor, Mich.
INVESTIGATION OF ELECTROMAGNETIC FIELDS IN THE FOCAL REGIONS OF A PARABOLOID RECEIVING OFF-AXIS Final Report, 13 Dec. 1965-15 Jul. 1966
Irvin W. Kay and Morton Goldberg 24 Jun. 1966 90 p refs
(Contract AF 19(628)-5812)
(D5220-448-P410; AFCRL-66-461; AD-637882) CFSTI: HC $3.00/MF $0.65

The problem of evaluating numerically the Debye-Picht Lunsberg electromagnetic diffraction integrals in the short wavelength limit was investigated, and the method of stationary phase for evaluating these integrals was generalized for application to caustic regions. A test problem, involving the diffraction of a plane wave by a perfectly conducting paraboloidal reflector, was considered in this investigation. Results of sample calculations illustrating the techniques evolved are discussed. Author (TAB)

N67-29901*# Massachusetts Inst. of Tech., Cambridge.
THE APPLICATION OF STATE-VARIABLE TECHNIQUES TO COMMUNICATION AND RADAR PROBLEMS
[1966] 61 p refs Abstracts of Papers Presented at the Western Elec. Show and Conv., Los Angeles, 23-26 Aug. 1966
(Grant NsG-334)
(NASA-CR-76277) CFSTI: HC $3.00/MF $0.65 CSCL 17B

CONTENTS:

1. DETECTION AND CONTINUOUS ESTIMATION: THE FUNDAMENTAL ROLE OF THE OPTIMUM REALIZABLE LINEAR FILTER H. L. Van Trees 6 p refs (See N67-29902 16-07)

2. A THEORY OF CONTINUOUS NONLINEAR RECURSIVE-FILTERING WITH APPLICATION TO OPTIMUM ANALOG DEMODULATION D. L. Snyder 16 p refs (See N67-29903 16-07)

3. MAXIMUM A POSTERIORI INTERVAL ESTIMATION A. B. Baggeroer 18 p refs (See N67-29904 16-07)

4. SIGNAL OPTIMIZATION FOR ADDITIVE NOISE CHANNELS WITH FEEDBACK J. K. Omura (Stanford Univ.) 12 p refs (See N67-29905 16-07)

5. A MODERN SYSTEMS APPROACH TO SIGNAL DESIGN F. C. Schweppe (Lincoln Lab. MIT) 4 p (See N67-29906 16-07)

N67-29902*# Massachusetts Inst. of Tech., Cambridge.
DETECTION AND CONTINUOUS ESTIMATION: THE FUNDAMENTAL ROLE OF THE OPTIMUM REALIZABLE LINEAR FILTER
H. L. Van Trees *In its* The Appl. of State-Variable Tech. to Commun. and Radar Probl. [1966] 6 p refs (See N67-29901 16-07)
(Grant NsG-334)

The differential equation or state variable technique of representing dynamic systems for optimal control problems is discussed, and the fundamental role of the optimum linear filter is considered. A class of problems in which the optimum receiver may be either a linear or nonlinear system, and which contains a linear filter for solving the Wiener–Hopf equation, is discussed. Estimator equations are derived, and two alternative solutions are proposed: the impulse response method which characterizes the processes in terms of their covariance functions and the linear processor in terms of a time-varying impulse response; and the state variable method which characterizes the message and noise processes in terms of the vector differential equation describing the linear system. Their applications to the detection problems of known signal in colored and white noise, and of Gaussian signals in Gaussian noise are given. Nonlinear modulation problems are examined, and the advantages of the state variable method are cited. M.G.J.

N67-29903*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
A THEORY OF CONTINUOUS NONLINEAR RECURSIVE-FILTERING WITH APPLICATION TO OPTIMUM ANALOG DEMODULATION
Donald L. Snyder *In its* The Appl. of State-Variable Tech. to Commun. and Radar Probl. [1966] 16 p refs (See N67-29901 16-07)
(Grant NsG-334)

An approach is presented for the continuous nonlinear filtering or estimation problem. The approach is based on the use of Markov processes and state-variable concepts. Equations are derived for approximate minimum-mean-square-error (MMSE) estimates of a Markovian state vector observed in a signal in which it is imbedded nonlinearly. A general model for analog communication via randomly time-varying channels is defined and related to the state vector estimation problem. The model includes as special cases such linear and nonlinear modulation schemes as AM, PM, FM, and PM_n/PM; and such continuous channels as Rayleigh and Rician channels, fixed channels with memory, and diversity channels. The approach leads automatically to physically realizable demodulators whose outputs are approximate MMSE estimates of the message and, if desired, the channel disturbances. Author

N67-29904*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
MAXIMUM A POSTERIORI INTERVAL ESTIMATION
Arthur B. Baggeroer *In its* The Appl. of State-Variable Tech. to Commun. and Radar Probl. [1966] 16 p refs (See N67-29901 16-07)
(Grant NsG-334)

The problem of determining the maximum a posteriori (MAP) estimate of a state vector of a random process within an interval is considered. A set of differential equations is derived by using Lagrangian multipliers and the calculus of variations. In the case of a linear state-vector equation and a linear modulator, the estimate at the interval end point is shown to be identical to the realizable estimate, and then a convenient means of implementing the MAP receiver by using this estimate is shown. The solution to the problem of filtering with a fixed delay is also derived from the MAP estimation equations. For the linear case, a differential equation satisfying the error is derived. From this, a differential equation for the covariance of the error matrix is derived. A solution is given by finding the appropriate integrating factor and then using the covariance of error matrix for the end-point estimate. Author

N67-29905*# Stanford Univ., Calif.
SIGNAL OPTIMIZATION FOR ADDITIVE NOISE CHANNELS WITH FEEDBACK
Jim K. Omura *In* MIT The Appl. of State-Variable Tech. to Commun. and Radar Probl. [1966] 12 p refs (See N67-29901 16-07)
(Contract AF 49(683)-1517; Nonr-225(83))

A communication receiver is regarded as a dynamical system described by a difference equation where the last state is the test statistics upon which a decision is based. When noiseless feedback to the transmitter is allowed it is observed that the signal selection problem is essentially a stochastic control problem. With an appropriate criterion signals are found that exploit the feedback to achieve considerable reduction in coding and decoding complexity over what would be needed for comparable performance with the best known signals for the one way channel. This control theory approach depends only on the first and second order statistics of the noise, handles multiplicative noise in addition to additive noise in the forward channel, and naturally extends to consideration of noise in the feedback link. Author

N67-29906*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A MODERN SYSTEMS APPROACH TO SIGNAL DESIGN
Fred C. Schweppe *In* MIT The Appl. of State-Variable Tech. to Commun. and Radar Probl. [1966] 4 p (See N67-29901 16-07)

The use of modern systems theory as a viable approach to many signal design problems of communication and radar systems is discussed. The theory is characterized by the use of state variable concepts and optimization techniques such as Pontryagin's maximum principle. State variable models are used so that the system performance can be considered as the output of a dynamical system (the Riccati equation) whose input is the signal (signal set). Given such a model, the signal design proceeds directly using the techniques of optimal control theory. Two cases are considered: decision making, and state estimation. For both problems, the performance is evaluated in terms of the solution of a matrix Riccati equation which is a first order, nonlinear matrix system of ordinary differential equations with time as the independent variable. M.G.J.

N67-29978# National Aerospace Lab., Tokyo (Japan).
DYNAMIC CHARACTERISTICS OF FM MULTICHANNEL TELEMETERING SYSTEM
Keiji Nitta, Yoshio Sakurai, and Yoshitsugu Matsuzaki 1966 12 p refs In JAPANESE; ENGLISH summary
(NAL-TR-124)

According to the theoretical analysis on the FM multichannel telemetering system, the following conclusions were obtained: (1) In the situation of sweeping the information signal frequency, the change of the transmission time caused by phase characteristics is not significant, but that of output amplitude is sufficient to be minded. (2) Higher harmonics in demodulated output, caused by phase distortion, is remarkable, and especially, the effect of inserted band pass filter followed by the discriminator is most important. (3) The interchannel crosstalk level in each channel caused by the video transmitting system, which has 10% nonlinearity value, is about 0.5% distortion factor. (4) The expected value of the distortion factor through the whole system is about 3%. Author

N67-30141*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NIMBUS VERSATILE INFORMATION PROCESSOR (VIP) SATELLITE SYSTEM
Paul Feinberg Mar. 1967 35 p
(NASA-TM-X-55821; X-731-67-156) CSCL 09F

Satellite telemetry systems in the past have been tailored to a particular mission or a predetermined set of experimental requirements. A unique telemetry system concept has been developed and will be implemented on the Nimbus D satellite which will provide a great degree of flexibility in the sampling and formatting of experimental or housekeeping data—the flexibility being achieved without design or wiring changes. This new system is called the Versatile Information Processor (VIP). Author

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-28992# RAND Corp., Santa Monica, Calif.
JOSS: DISC FILE SYSTEM
I. D. Greenwald Feb. 1967 41 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5257-PR; AD-650128) CFSTI: HC $3.00/MF $0.65

JOSS is a multi-user, single-server computing system that provides for the solution of numerical problems. The system consists of a central computer containing the JOSS program and a number of typewriter consoles connected to the computer via telephone lines. The JOSS filing system provides the individual user with a service that will save him the need for retyping frequently used programs and/or data. The memorandum describes the JOSS filing system, and is intended primarily as program documentation for maintenance personnel, particularly those who may need to correct or modify the file-handling routines. The report may have interest for others, however, since it includes the rationale for more critical decisions and techniques. Author (TAB)

N67-29072# Philco Corp., Blue Bell, Pa. Microelectronics Div.
R AND D OF THE TECHNOLOGIES REQUIRED TO DESIGN AND FABRICATE ULTRAHIGH-SPEED COMPUTER SYSTEMS Interim Report, 1 Oct.–31 Dec. 1966
31 Dec. 1966 35 p Prepared for MIT
(Contract AF 19(628)-5167)
(ESD-TR-67-181; IR-10; AD-650628) CFSTI: HC $3.00/MF $0.65

A description is given of the work performed during the second quarter of the research and development program 'R + D of The Technologies Required to Design and Fabricate Ultrahigh-Speed Computer Systems.' The fabrication and evaluation phases of the 3-, 9-, and 27-bit parity arrays continued. In the area of new microcircuits, two new ECL designs, the SMX8 and SMX7, were completed. Author (TAB)

N67-29077# RAND Corp., Santa Monica, Calif.
THE COMING COMPUTER UTILITY—LAISSEZ-FAIRE, LICENSING OR REGULATION?
Paul Baran Apr. 1967 28 p Submitted for publication
(P-3466; AD-650945) CFSTI: HC $3.00/MF $0.65

We are moving headlong into an era where information processing will be available the same way one buys his electricity. But the attributes that distinguish heterogeneous information from the homogeneous products distributed by the earlier utilities are so different that a fresh regulatory approach is needed for technological progress, safety, and the public interest. We may want to think of this as tomorrows problem. But tomorrow is here. Author (TAB)

N67-29122# Washington Univ., Seattle. Dept. of Physiology and Biophysics.
FURTHER DEVELOPMENT OF THE BIOTHERMAL ANALOG COMPUTER Final Report, Feb. 1963–Jan. 1966
Arthur C. Brown Nov. 1966 67 p ref
(Contract AF 33(657)-10838)
(AMRL-TR-66-197; AD-650729) CFSTI: HC $3.00/MF $0.65

An electronic analog computer, designed to enable calculation of the response of man to thermal stress, was developed. In accordance with equations previously developed (c.f. AD-428 144), the computer circuits were used to simulate the physical distribution of heat within the body, the thermal stress imposed by the environment, and the physiological mechanisms of homeostatic feedback. Computer predictions were compared with experimental results from cyclic thermal stresses furnished by Lieutenant Colonel W. C. Kaufman, AMRL, and agreement was found to be good. The computer was used to calculate human response to wearing of an unventilated anti-exposure suit. The technical aspects of the computer circuits are presented in detail. Author (TAB)

N67-29178*# Rochester Univ., N. Y. Dept. of Electrical Engineering.
INVESTIGATION OF COMPUTER-AIDED CIRCUIT DESIGN. PART I: SYNTHESIS OF DISTRIBUTED SYSTEMS. PART II: SIGNAL FLOW GRAPH APPROACH TO COMPUTER-AIDED DESIGN Semiannual Report, 1 Sep. 1966–28 Feb. 1967
Gerald H. Cohen 28 Feb. 1967 23 p refs
(Grant NGR-33-019-058)
(NASA-CR-66402) CSCL 09B

Consideration is given to adapting a modern hybrid computing facility to the synthesis of systems where the active as well as passive elements may be distributed in space or where combinations of lumped devices and distributed transmission systems may exist. The viewpoint taken is that the distributed parameters are to be optimized so as to achieve a cost or penalty function minimization. The result is a determination of the optimal electrical properties of the media as a function of position in the direction of wave propagation. It is shown how the synthesis part of the design can be handled using a hybrid computer to solve the variational problem. The second part of the paper is devoted to demonstrating how the hybrid computer will carry out the rest of the design procedure. After the digital computer has digested the information presented to it by the CRT display, a program has been written to plot the signal flow graph automatically from the flow graph connection matrix. A Gauss elimination technique is used to solve for any of the variables. L.E.W.

N67-29401# Lincoln Lab., Mass. Inst. of Tech., Lexington.
LINCOLN LABORATORY MULTI-PROGRAMMING SUPERVISOR
Frank Belvin and Joel M. Winett 6 Jan. 1967 183 p *Its* Manual 78
(Contract AF 19(628)-5167)
(ESD-TR-67-14; AD-650190) CFSTI: HC $3.00/MF $0.65

A supervisor program was written for the IBM system/360 which allows the multi-programming of several jobs, each with its own input–output requirements. Author (TAB)

N67-29418# Burroughs Corp., Paoli, Pa. Defense, Space and Special Systems Group.
DETECTION OF ESSENTIAL ORDERING IMPLICIT IN COMPILER LANGUAGE PROGRAMS Quarterly Technical Report, 15 Oct. 1966–20 Jan. 1967
Harvey W. Bingham, David A. Fisher, and Warren L. Semon Feb. 1967 41 p refs
(Contract DA-28-043-AMC-02463(E))
(Rept.-2; QR-2; ECOM-02463-2; AD-650845) CFSTI: HC $3.00/MF $0.65

An investigation was made to determine how implicit parallelism in programs written in compiler languages can be recognized and exploited by machines with highly parallel organizations. An algorithm is described which identifies the

complete serial ordering among parts of a program based on the input–output sets of these parts, the ordering given by the programmer, and any known essential order among the program parts. The algorithm is proved and a demonstration given that a minimum number of comparisons of input–output sets are made. Application of the parallel recognition procedure to subroutines, loops, conditionals, recursive subroutines, and serial input–output device calls is explained. The effect of particular features of several compiler languages on parallelism are discussed. These features include loops, transfers of control, conditionals, and conditional sequences. Requirements for replacing iterative loop control by parallel paths of control are given. Alternative algorithms for recognizing essential ordering are suggested which can be executed more effectively on a highly parallel machine. Application of the given algorithm to the syntactic definition of a context-free language is also considered. TAB

N67-29505# Hydraulic Research and Mfg. Co., Burbank, Calif. Systems Development Dept.

DEVELOPMENT OF A ±7 BIT PARALLEL BINARY DIGITAL SERVOVALVE

China Lake, Calif., NOTS. Mar. 1967 179 p refs

(Contract N123(60530)54356A)

(NOTS-TP-4298; AD-649944) CFSTI: HC $3.00/MF $0.65

The report describes the development and developmental testing of a digital servovalve designed to provide a flow output proportional to plus or minus 7 bit parallel binary two's complement input signals. The digital servovalve, which acts as an interface between a digital computer and a hydraulic-power-driven analog responder, converts the digital input to the servovalve to an analog flow output used to position the responder. The unit is a standard HR+M Company second-stage mechanical feedback servovalve driven by a digital torquer operating in the area of torque output saturation. The torquer consists of eight solenoidal bits, seven of which are positive torque output devices, while the eighth most significant bit is negative. The mechanical summation of torques is accomplished by applying the array of torques to a common rotor. The rotor receives feedback torque from the second-stage position, which drives the summation of torques to zero. Tests of three experimental digital servovalve units established that the design meets specified requirements, and the valve has been tested in the direct digital control of a missile-launcher hydraulic power drive. Author (TAB)

N67-29508# Massachusetts Inst. of Tech., Cambridge.

COMPUTER DESIGN FOR ASYNCHRONOUSLY REPRODUCIBLE MULTIPROCESSING

Earl C. Van Horn, Jr. (Ph.D. Thesis) Nov. 1966 254 p refs

(Contract Nonr-4102(01))

(MAC-TR-34(Thesis); AD-650407) CFSTI: HC $3.00/MF $0.65

A concept is presented for designing either a computing system, or a programming language system, so that the following problem is avoided: during a multiprocess computation (several processes communicate, and the relative timing of the performance of the processes is arbitrary) the output produced by the computation might not be a function of only the initial computation state; i.e., of only inputs and initial program of the computation. The design concept for avoiding this problem is explained by defining an apparently new class of abstract machines called Machines for Coordinated Multiprocessing, or MCMs. Processes are coordinated in an MCM by means of a count matrix, which may be modified by actions of processes, and which determines the processes enabled to proceed at any instant. Remarks suggest that a computing facility which behaves like an MCM can be constructed and programmed at reasonable cost. It is proved that every MCM has the properties of output functionality and output assuredness: output functionality means that each symbol in every output stream is a function only of the initial computation state; output assuredness, that for each output stream the maximum number of symbols produced in the stream (or fact that the number of such symbols has no upper bound) is a function only of the initial computation state. Author (TAB)

N67-29551# Stanford Research Inst., Menlo Park, Calif.

GRAPHICAL-DATA-PROCESSING RESEARCH STUDY AND EXPERIMENTAL INVESTIGATION Quarterly Report, 1 Nov. 1966–31 Jan. 1967

Richard O. Duda, Peter E. Hart, and John A. Munson Mar. 1967 59 p refs

(Contract DA-28-043-AMC-01901(E))

(ECOM-01901-26; QR-4; Rept.-26, AD-650926) CFSTI: HC $3.00/MF $0.65

The report describes the continuing development of preprocessing, classification, and context analysis techniques for hand-printed text, which are advancing at an accelerating pace. Experiments were continued with the Piecewise-Linear learning machine, using the outputs of two preprocessors: the PREP 24A simulation of the 1024-image optical preprocessor, and the CALMMASK preprocessor, which employs both edge-detecting and corner-detecting masks. A new low test error rate for classification was achieved on hand-printed alphabets of FORTRAN characters. Statistics of the performance of the learning machine during a single testing iteration are presented, and shed light on several important questions, such as the distribution of rankings of the desired character category when it is not in first place. A discussion of the preprocessing methods used in the topological approach to preprocessing and classification is begun. The initial development of a FORTRAN syntax analyzer is described. A milestone was reached with the passage of a small sample of actual FORTRAN text from a coding sheet through the scanning, preprocessing, classification, and syntax-analysis programs. Author (TAB)

N67-29681 Texas Univ., Austin. Linguistics Research Center.

DYNAMIC ADAPTIVE DATA BASE MANAGEMENT STUDY Second Quarterly Progress Report, 16 Aug.–16 Nov. 1966

Winfred P. Lehmann and Eugene D. Pendergraft Feb. 1967 37 p refs

(Contract DA-28-043-AMC-02276(E))

(ECOM-02276-2; AD-649784) CFSTI: HC $3.00/MF $0.65

The feasibility of dynamic adaptive data base management is being investigated using linguistically specified processors, automatic classification based on clumping theory, and a monitoring system capable of exercising judgment concerning the need for automatic revision of the data base. TAB

N67-29682# RAND Corp., Santa Monica, Calif.

JOSS: CONSOLE DESIGN

C. L. Baker Feb. 1967 124 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5218-PR; AD-650034) CFSTI: HC $3.00/MF $0.65

The report describes the development at RAND of a remote typewriter console for use with JOSS, RAND's personal on-line computing service, and demonstrates the extreme care that must be taken to design an acceptable console for personal use by casual users. The input/output version of the familiar IBM Selectric was selected as the central element of the console because of its excellent keyboard feel, its high-quality output at a speed of 150 words per minute, its compact size, and its relatively low noise level. Primary considerations in the design of a console to house the typewriter included dimensions required for operator comfort and convenience, console mobility, the projected number of required electronic components and their packaging, and the incorporation of the associated switches and indicator lights in a small auxiliary control box. Discussion of the physical console is followed by an overview of the logic required to enable the user and JOSS to share the typewriter productively in an interactive conversation. Finally, a detailed description of this logical design is given in hardware terms. TAB

N67-29864# California Univ., La Jolla. Scripps Inst. of Oceanography.
AUTOMATICALLY CONVERTING A STANDARD NUMERICAL STRIP PRINTER SO AS TO COMBINE TWO-DIMENSIONAL PULSE ANALYZER INFORMATION INTO A CONVENIENT PAGE
T. R. Folsom, W. E. Weitz, and J. M. Moore 15 Jan. 1967 34 p
(Contract AT(11-1)-34)
(TID-23748) CFSTI: HC $3.00/MF $0.65

A new system is described that allows digital information in the memory matrix of a two-dimensional pulse height analyzer to be read out into a page that is convenient to study and file. The 4096 number matrix on this page, obtained automatically in about four minutes, permits immediate inspection of signal peaks so that effective programs can be selected for final analysis of the data by a computer. New mechanical and electrical accessories were devised for automatically cutting off and stapling together short strips of paper from a standard strip printer to produce a 11" × 42" page displaying a matrix of 4096 signal numbers and channel markers. This is easy to read, study, and display to an audience; it may be filed in a standard letterhead-size filing cabinet after folding. The new system is especially useful for study of arrays of very small numbers derived from measurements of very small traces of radionuclides. Cathode ray presentation then are generally not satisfactory. Author (NSA)

N67-30018 Joint Publications Research Service, Washington, D. C.
THE USE OF COMPUTERS IN SCIENTIFIC EXPERIMENTS
B. Petrov et al 19 May 1967 7 p Transl. into ENGLISH from Izv. (Moscow), 11 Mar. 1967, p 3
(JPRS-41080; TT-67-31721) CFSTI: $3.00

Presented is a discussion of the feasibility of using computing machines for processing data and for planning scientific experiments. It is surmised that computers can be of use during experimental observations of various phenomena and serve in the selection of important information; the study of artificially produced processes; and in cybernetic studies. Reasons for the slow incorporation of computers in scientific experiments, such as limitations in design and the inability of scientists to recognize the potentialities of computers during experimental phases of research, are cited. To overcome these problems, it is suggested that: (1) computer techniques be incorporated into educational programs so that students will be aware of their usefulness; and (2) workers in scientific research organizations be reorganized so as to give them a broader acquaintance with modern systems of processing experimental data and with their prospects for development. S.C.W.

N67-30137*# International Business Machines Corp., N. Y.
STUDY OF CONTROL COMPUTERS FOR CONTROL MOMENT GYRO STABILITY AND CONTROL SYSTEMS. VOLUME II: SIMULATION
D. P. Bedford, H. Markarian, and N. L. Pleszkoch Mar. 1967 283 p
(Contract NAS1-6698)
(NASA-CR-66374) CSCL 09B

A digital computer program that simulates the control moment gyro (CMG) is discussed. The CMG stability and control system is used in an Apollo spacecraft to perform typical control tasks required for experiments such as horizon spectrometry, earth mapping, and solar astronomy. The program is used for aid in evaluating the performance of CMGs that are controlled by an on-board digital computer in many attitude control situations. The CMG uses a main program and 31 subroutines. Each routine is described and listings, routine linkage, purpose and references to source equations, and supporting figures are included. S.P.

N67-30155*# International Business Machines Corp. New York
STUDY OF CONTROL COMPUTERS FOR CONTROL MOMENT GYRO STABILITY AND CONTROL SYSTEMS. VOLUME I: ENGINEERING
D. P. Bedford, H. Markarian, and N. L. Pleszkoch Mar. 1967 146 p refs
(Contract NAS1-6698)
(NASA-CR-66373) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The study has two objectives. The first objective was to perform an analysis of the control computer computational requirements. This included preliminary hardware sizing for a control moment gyro (CMG) stability and control system used in an Apollo Applications Spacecraft to perform typical control tasks required for experiments such as horizon spectrometry, earth mapping, and solar astronomy. The second objective was to develop a fixed word-length, digital model of the control computer to be incorporated in a sample-data simulation of the integrated CMG control system for manned spacecraft. The final report comprises two volumes. Volume I describes the overall engineering analyses, and Volume II discusses the digital simulation program from a user's viewpoint. Author

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-28989# Radio Corp. of America, Lancaster, Pa. Electronic Components and Devices Div.
CESIUM VAPOR CATHODE DEVELOPMENT Final Report, 1 Aug. 1965–30 Aug. 1966
W. N. Parker and F. G. Hammersand Griffiss AFB, N. Y., RADC Jan. 1967 215 p refs
(Contract AF 30(602)-3241)
(RADC-TR-66-715; AD-649935) CFSTI: HC $3.00/MF $0.65

The objective of the program was to develop design data to establish feasibility of using a cesium vapor cathode in a practical tube type. The theoretical investigation indicated that in klystrons, traveling wave tubes and backward wave oscillators the cesium cathode has definite possibilities for application. A practical design of a cesium vapor cathode produced 330 amperes per square centimeter which was extracted from a 0.030 inch diameter cathode exit aperture and was accelerated to a beam potential of 8kV under 5 microsecond pulsed dc conditions. Using magnetic focusing, beam transmissions, efficiencies of up to 90% can be obtained through a 0.060 inch diameter, one inch long drift tube. Cesium trapping, recirculation and gettering techniques were also investigated in conjunction with studies of the effects of cesium reaction with various materials used in electron tube fabrication. Author (TAB)

N67-29050# Burndy Corp., Norwalk, Conn.
PRODUCTION ENGINEERING OF TRIAXIAL PULSE CONNECTORS Summary Engineering Report, 15 Jun. 1961–31 Dec. 1966
Leonard H. Feldberg and Mark Auriana Apr. 1967 153 p
(Contract DA-36-039-SC-85964)
(AD-651193) CFSTI: HC $3.00/MF $0.65

The report relates to the entire engineering and production effort as performed on the subject triaxial pulse connectors. It deals in detail with the major technical (economic as well as manufacture and function) problems encountered during the course of this project. These are as follows: (1) the cable, (2) the field termination assemble ability of the cable to the plug half of the connector, (3) the primary receptacle of the insulator. Author (TAB)

N67-29069# Lincoln Lab., Mass. Inst. of Tech., Lexington.
OPERATIONAL LOW-POWER, LOW- TO HIGH-FREQUENCY DIGITAL CIRCUIT ELEMENTS: REFINEMENTS, CHARACTERISTICS AND DEVELOPMENTS
Donald E. Chace 24 Jan. 1967 78 p ref
(Contract AF 19(628)-5167)
(ESD-TR-67-45; TN-1967-10; AD-650779) CFSTI: HC $3.00/MF $0.65

This report contains various configurations of operational low-power digital circuit elements which have been refined and/or developed to carry out many functional requirements of digital system designs. Although they are primarily intended for use in space-oriented digital system applications, e.g., the Lincoln Experimental Satellite (LES) program, the configurations need not be limited to this purpose. Characteristic operational data are included in all cases to point out various circuit requirements, capabilities and limitations. A myriad of flip-flop configurations is provided to promote efficient systems design in regards to power consumption, noise immunity and cost. Section IV covers some design considerations relating to high-speed, low-power flip-flop development. TAB

N67-29074# Machlett Labs., Inc., Springdale, Conn.
GRIDDED AMPLIFIER TUBES FOR PULSED C-BAND FREQUENCIES Quarterly Report, 15 Sep.–14 Dec. 1966
W. Brunhart and A. J. Pineau Mar. 1967 26 p
(Contract DA-28-043-AMC-01665(E))
(ECOM-01665-5; QR-5; RCS-OSD-1366; AD-650006) CFSTI: HC $3.00/MF $0.65

The first operable triodes of the EE 53 design were processed and evaluated. The processing of additional triodes has been delayed to allow for elimination of problems caused by a recent supply of deficient materials. Means of supporting the grid wire and its implementation into the overall processing cycle are under study: Initial amplifier tests using two triodes with insufficient emission have been conducted. At peak currents of 1/8 of the required level a 6 db gain was demonstrated over 100 MHz passband. The interresonator coupling in the output circuit will increase the bandwidth to 1000 MHz. With an improved coupling into the input and with tubes having good emission a substantial improvement in gain bandwidth product is expected. Author (TAB)

N67-29078# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
EXPERIMENTAL BAND-PASS LIMITER ENVELOPE DISTRIBUTIONS AND STATISTICS Interim Report, Jun. 1966–Jan. 1967
Donald W. Tufts and Paul Trafton 10 Jan. 1967 36 p refs
(Contract Nonr-1866(16))
(TR-523; AD-650946) CFSTI: HC $3.00/MF $0.65

A method is developed for approximately predicting the mean and standard deviation of the output of a detection system consisting of a band-pass limiter followed by an envelope detector. The input to the system consists of a sinusoidal signal plus Gaussian noise plus sinusoidal interference. These results are used to predict detection and false alarm probabilities. Experimental data is presented and compared with predicted results. Author (TAB)

N67-29087# Naval Ammunition Depot, Crane, Ind.
μ-NOTES NO. 19
3 Apr. 1967 157 p
(AD-650317) CFSTI: HC $3.00/MF $0.65

The report presents information on evaluation application, availability, research and development, and standardization activity pertaining to state-of-the-art microelectronic circuits, devices, and materials. TAB

N67-29089# Radio Corp. of America, New York. CSD Advanced Communications Technology Lab.
SIGNAL ENHANCEMENT TECHNIQUES Quarterly Progress Report, 1 Nov. 1966–31 Jan. 1967
P. Torrione Mar. 1967 33 p refs
(Contract DA-28-043-AMC-02280(E))
(QPR-3; Rept.-3; ECOM-02280-3; AD-649730) CFSTI: HC $3.00/MF $0.65

The theory of hot-carrier mixer diodes is presented, and the relationship between diode characteristics and mixer performance is evaluated. The hot-carrier diode is studied relative to the p-n junction and point contact diodes in this range of frequencies below 3 GHz. The conversion loss and noise figure of a frequency converter using hot-carrier diodes has been studied and evaluated. The report also contains an evaluation of conversion loss for a general nonlinear i-v characteristic. Results are presented for a converter with various image terminations and various degrees of nonlinearity. The cooled diode has also been studied as a circuit element in a frequency converter. The theoretical study presented here describes the benefits to be gained from a cooled hot-carrier mixer. Author (TAB)

N67-29104# Varian Associates, San Carlos, Calif. EIMAC Div.
DEVELOPMENT OF LINEAR POWER TUBES Interim Development Report, 17 Nov. 1966–16 Feb. 1967
William H. Sain 20 Mar. 1967 56 p refs
(Contract N00024-67-C-1044)
(AD-650814) CFSTI: HC $3.00/MF $0.65

Two Phase I (200 - 500 watts PEP output) UHF tetrodes were made and tested at full power output. Third and fifth order intermodulation distortion product ratios were -40 db or better at more than fifty per cent plate circuit efficiency. Distortion calculations from the grid-plate transfer curves showed that the optimum (for minimum distortion) zero signal plate current was above the desirable level. Experimental Phase I tubes designed to operate at lower zero signal plate current and higher plate efficiency are under construction. Tests of an EIMAC linear tetrode, the 4CX1500B, showed that the linearity of this type is strongly dependent on the quiescent plate current and, to a lesser extent, on the screen grid voltage. Author (TAB)

N67-29148*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRONICS PARTS ENGINEERING
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 81–83 (See N67-29141 16-34)

The effects of nuclear and gamma radiation on electronic parts for 10,000 hr with and without nominal electrical stress were investigated. Capacitors, diodes, transistors, resistors, relays, and switches were exposed, and the results are discussed. Vacuum had no apparent effect, but temperature and power were found to cause degradation in some parts. N.E.N.

N67-29157*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SCIENCE DATA SYSTEMS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 209–216 refs (See N67-29141 16-34)

A mathematical discussion is presented on near-maximal-length cycles with linear feedback shift registers (FSR). The generalized r-stage FSR and the minimal polynomial of the T and A matrices are considered. Characteristic polynomial derivations for cycle lengths of 2^k-2 and 2^k-4 and the implementation of near-maximal linear FSRs are presented. N.E.N.

N67-29237# Radio Corp. of America, New York. Advanced Communications Technology Lab.
MICROMINIATURE MONOLITHIC CROSSPOINT INTERCONNECTIONS Quarterly Report, 1 Oct.–31 Dec. 1966

S. Yuan, W. H. Buchsbaum, M. Kalet, and L. Spann Apr. 1967 40 p refs
(Contract DA-28-043-AMC-02260(E))
(CR-67-565-7; Rept.-2; QR-2; ECOM-02260-2; AD-650108) CFSTI: HC $3.00/MF $0.65

The report describes the circuit and the fabrication aspects of the microminiature monolithic crosspoints. Control circuits using DC amplifiers, logic gates, or both are discussed to ascertain the operating conditions of the crosspoints and the power required per crosspoint. Drive voltage necessary as a function of the shunt resistance and the diode forward resistance is determined, so that the proper control elements can be chosen. Insertion loss as a function of the shunt resistance and the diode forward resistance is also determined, so that line amplifiers with adequate gain may be used to compensate for the insertion loss of any transmission path. The characteristics of the glass-embedded diodes has been measured and found satisfactory. The glass surface condition has been adequately prepared for deposition of uniform resistors. The reasons for using the nichrome resistors instead of the Pt-Rh resistors for the crosspoints are given, and results of the uniformity of the nichrome resistors are presented. Data on the Type B crosspoints fabricated and their electrical characteristics are also given. Author (TAB)

N67-29263# Los Alamos Scientific Lab., N. Mex.
FAST AUTOMATIC PHASE AND AMPLITUDE CONTROL OF HIGH-POWER RF SYSTEMS
Robert A. Jameson and William J. Hoffert [1966] 12 p refs
Presented at Natl. Particle Accelerator Conf., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-8344; CONF-670307-18) CFSTI: HC $3.00/MF $0.65

Recent progress in the design and testing of the fast feedback rf control system being developed for the Los Alamos Meson Physics Facility (LAMPF) proton linac is reviewed. Closed-loop rf phase control with correction bandwidths greater than 200 kHz is demonstrated using a coaxitron power amplifier driving a full-scale accelerator structure. Proposed experimental studies to determine control characteristics, synthesize closed-loop amplitude control systems, and study phase-amplitude interactions in 1.25-MW, 6% duty factor klystron, triode, and crossed-field amplifier systems are outlined. Extremely phase-stable frequency sources have been developed to supply reference signals at 201.25 MHz and 805 MHz. The design and testing techniques used to verify phase stability and mutual coherence of the harmonically related outputs are summarized. Author (NSA)

N67-29428*# General Electric Co., Daytona Beach, Fla.
SINGLE PARAMETER TESTING
C. A. Grunden and J. T. Sterling 4 May 1967 43 p refs
(Contract NAS8-11715)
(NASA-CR-61171) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This report presents the results obtained in evaluating two testing techniques for determining off-nominal parameter values of a component. These two techniques are the use of growing exponential probing signals with an orthogonal filter bank and the use of transient response sampling. The results obtained in testing linear and some nonlinear component models are described and the conclusions reached when applying the transient response sampling technique to an ac amplifier and a dc amplifier are given. This report shows that single parameter testing techniques can be applied successfully to some components when using the technical and economic considerations recommended for the selection of a component to be tested. Author

N67-29474# Joint Publications Research Service, Washington, D. C.
PHASE SHIFTER FOR INFRALOW FREQUENCY RANGE
Ye. D. Koltik and S. A. Kravchenko *In its* Correlation Function Meas. and Infralow Freq. Devices 2 May 1967 p 3-6 Transl. into ENGLISH from Russian Patent no. 171046, Buyl. Izobret. i Tovarnykh Znakov (Moscow), no. 10, 11 May 1965 (See N67-29472 16-14)

Details are given on a proposed phase shifter for the infralow frequency range which consists of a quartz master oscillator, a high frequency squared pulse shaper, a conversion circuit, an amplitude limiter, a circuit for measuring the phase shift increments, a phase inverter, and output amplifiers. To obtain a sinusoidal signal from low frequency square pulses, an analog computer circuit is used. This functions as an adjustable filter and consists of two integrators and a phase inverter encompassed by feedback. Author

N67-29494# Microsemiconductor Corp., Culver City, Calif.
45 KILOVOLT MULTIPLIER. VOLUME II: PART I Final Report
E. S. Resnond and M. W. Stillwell [1966] 75 p
(Contract DA-44-009-AMC-611(T))
(AD-649011) CFSTI: HC $3.00/MF $0.65

The life expectancy MTBF was shown to be greater than 3000 hours. This performance exceeds contract requirements by over 50 percent. The major causes for multiplier failures were isolated and processing procedures to remove these failure mechanisms were established. The capacitor was the major contributor to the failure of the multiplier. This was demonstrated in the burn-in cycle of the manufacturing process. The success in processing the capacitor was proven by the life test (3110 MTBF) and this life expectancy was obtained after a great deal of effort and time was spent to develop the process and procedures for the handling of the capacitor. TAB

N67-29513# Varian Associates, Palo Alto, Calif.
INVESTIGATION OF ELECTRONIC INTERACTION WITH OPTICAL RESONATORS FOR MICROWAVE GENERATION AND AMPLIFICATION Quarterly Report, 16 Jun.-15 Sep. 1966
Howard Jory Ft. Monmouth, N. J., ECOM, Mar. 1967 20 p refs
(Contract DA-28-043-AMC-01873(E))
(ECOM-01873-6; QR-6; AD-649683) CFSTI: HC $3.00/MF $0.65

Additional measurements with the TE sub 10, 1, 1 monotron oscillator are reported. The results support the conclusion that the observed milimeter-wave output power is the result of harmonic generation. The program to observe monotron oscillations or beam negative resistance effects is described. So far these effects have not been observed. Changes are described which have been made to increase the stability and flexibility of the experimental system. The method of measuring beam voltage was checked. It was found that because of magnetic field fringing the values of beam voltage obtained from orbit diameter measurements may be in error. The plans to remedy this situation by redesign of the polepiece are discussed. Possibilities for improving the previous analytical work are considered. The angular velocity modulation resulting from relativistic mass effects is discussed. This effect appears to be of considerable importance in devices of this type. The relative importance of cavity fields other than azimuthal electric field is reviewed. Author (TAB)

N67-29514# Bell Telephone Labs., Inc., New York.
EFFECTS OF RADIATION ON SEMICONDUCTOR MATERIALS AND DEVICES Final Report, 1 Oct. 1964-30 Nov. 1966
D. K. Wilson, J. P. Mitchell, J. D. Cuthbert, and R. R. Blair 31 Dec. 1966 256 p refs
(Contract AF 19(628)-4157)
(AFCRL-67-0068; AD-650195) CFSTI: HC $3.00/MF $0.65

Results of investigations on the effects of nuclear radiation on semiconductor materials, device surfaces, and devices are discussed. Radiation damage in gallium phosphide was studied using electro- and cathodo-luminescence. Studies were also made of radiative and non-radiative recombination mechanisms in various compound and elemental semiconductors. A non-radiative Auger-type mechanism observed at neutral defect centers appears to explain non-radiative lifetime degradation from both chemical and radiation damage defects. The Fermi level dependence of the ESR spectrum associated with the phosphorus-vacancy complex was studied in electron-bombarded, phosphorus-doped LOPEX silicon. These studies confirm one assumption that the Si-G8 (E) center is not seen until the Fermi level falls below E sub C -0.48 eV. Experiments to determine the effects of device bias, temperature, and radiation dose rate on surface damage to MOS FETs showed qualitative agreement with a model of positive space charge buildup at traps in the devices SiO2 layer. Author (TAB)

N67-29515# Microwave Associates, Inc., Burlington, Mass.
RESEARCH AND DEVELOPMENT OF SEMICONDUCTOR DIODES FOR USE IN HARMONIC GENERATOR APPLICATIONS USING SINGLE DIODES Quarterly Progress Report, 20 Sep.–19 Dec. 1966
Henri R. Chalifour and Peter Green [1966] 31 p
(Contract N00024-67-C-1018)
(QPR-1; AD-650325) CFSTI: HC $3.00/MF $0.65

The high-order multiplier circuit to be developed must produce one watt of output power at 12 gigahertz and at 10 percent efficiency. The multiplication factor is nine or greater. The power requirement for this multiplier requires that the diode used have a breakdown voltage in the order of sixty volts and a capacitance of three picofarads. In order to resonate this diode at the output frequency, the inductance should be 0.06 nanohenries. The smallest varactor package available has an inductance much higher than this value and a conventional cavity resonator using a packaged diode is thus impossible. The approach discussed uses a diode mounted in a radial transmission line resonator. The transmission line forms the diode package and has a radial length slightly over a quarter wavelength. The high-capacitive impedance at the radial line edge is therefore transformed to a low-inductive impedance necessary to resonate with the low-capacitive impedance at the diode. Author (TAB)

N67-29546# Microsemiconductor Corp., Culver City, Calif.
OSCILLATOR-HIGH VOLTAGE, VOLUME I Final Report
E. S. Resmond and M. W. Stillwell [1967] 94 p
(Contract DA-44-009-AMC-611(T))
(AD-649012) CFSTI: HC $3.00/MF $0.65

The final design of the high voltage oscillator fulfilling the electrical and mechanical requirements is basically a Colpitts type oscillator, constructed in two stages, known as a Darlington configuration. This configuration was chosen to provide ability to start at low temperature (-54C) and adjustment of output voltage without the sacrifice of regulation. Short circuit protection is provided as verified by a short circuit test lasting 24 hours at 52C. The core is a controlled gap type providing constant permeability over the specified temperature range which, in turn, provides constant frequency output over the range of input voltage. Temperature compensation was accomplished by placing a silicon diode in series with the emitter of the transistor. Manufacturing information is presented. TAB

N67-29557# Lehigh Univ., Bethlehem, Pa.
SURFACE PROPERTIES OF GERMANIUM SEMICONDUCTORS Final Report, 1 Mar. 1964–31 Aug. 1966
A. C. Zettlemoyer 31 Aug. 1966 4 p
(Grant DA-ARO(D)-31-124-6525)
(Rept.-4720.4-C; AD-649919) CFSTI: HC $3.00/MF $0.65

A study was made to obtain information concerning the extent and mechanism of the adsorption of gases on clean and oxide-covered surfaces of germanium semiconductors, and to learn in specific cases whether or not changes in bulk doping affect the behavior of semiconductor surfaces. Author (TAB)

N67-29584# Syracuse Univ., N. Y. Dept. of Electrical Engineering.
COMPUTATIONS FOR LOADED WIRE LOOPS Final Report, Jun.–Dec. 1966
Roger F. Harrington and Joseph Mautz Griffiss AFB, N. Y., RADC Feb. 1967 181 p refs
(Contract AF 30(602)-4348)
(RADC-TR-67-8; AD-649901) CFSTI: HC $3.00/MF $0.65

The report gives formulas, curves, tables of computations, and computer programs for electromagnetic behavior of thin wire loops with arbitrary excitation and loading. Included are the network admittance parameters for the transmitter-load-receiver system, in terms of which additional computations can be performed by hand. The computer program is accurate for loops of loop-diameter to wire-diameter ratios of ten and larger, and for loop circumferences of five wavelengths and smaller. The tables give representative computations for loop-diameter to wire-diameter ratios of 15, 30, 60, 100, and 200, and for loop circumferences up to 4.71 wavelengths. Author (TAB)

N67-29606# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
MODULO-M LINEAR SEQUENTIAL CIRCUITS, PARTIAL RESPONSE SIGNALING FORMATS, AND SIGNAL FLOW GRAPHS
D. W. Tufts and C. V. Ramamoorthy Feb. 1967 27 p refs
(Contract Nonr-1866(16))
(TR-519; AD-650958) CFSTI: HC $3.00/MF $0.65

Signal flow graph techniques were developed for the analysis of modulo-m linear sequential circuits and of mixed systems containing both modulo-m adders and adders of real numbers. One of the main results is the proof that the rational generating function of a modulo-m linear sequential circuit can be obtained from the generating function of a topologically similar sampled data system (with integer branch gains) by simply replacing each integer valued coefficient in the latter generating function by its (mod m) equivalent. Besides the direct application to the analysis of modulo m sequential circuits and sequence generators, mixed systems which arise in the partial response signaling format for digital data transmission were also investigated. Author (TAB)

N67-29698# Los Alamos Scientific Lab., N. Mex.
OPTIMUM GENERATOR CHARACTERISTICS OF RF AMPLIFIERS FOR HEAVILY BEAM-LOADED ACCELERATORS
Thomas J. Boyd, Jr. and Robert A. Jameson [1966] 11 p
Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-8346; CONF-670307-14) CFSTI: HC $3.00/MF $0.65

As the beam loading is increased in a proton linear accelerator, it becomes increasingly more difficult to maintain the design gradient. To avoid excessive beam spill, this gradient must be controlled to a tolerance of $\approx \pm 1\%$ during the initial transient of beam turn-on and during any subsequent fluctuation in beam loading due to uncontrolled or programmed variations in the amount of beam injected. Since the beam obtains its energy from the field, more power must be supplied by the rf generator when the beam is on. High-power microwave triodes, klystrons, and crossed-field amplifiers are being evaluated as generators to drive the accelerator structure of the LAMPF proton linac. The delivery of power from these tubes to the time-varying load impedance presented by the linac is a complicated interplay among such factors as the internal design of the tube's active region and output coupling section, the

length of line between the generator and the load, and the coupling to the load. An optimum system design can enable the generator to provide a degree of self-compensation providing a programmed amount of power to match the changing load impedance. This eases the problem of providing fine control to the 1% tolerance by a closed-loop system. Experimental studies were conducted on each tube type. Author (NSA)

N67-29717# Missouri Univ., Rolla.
AUTOMATIC DATA ACQUISITION SYSTEM FOR SEMICONDUCTOR DEVICE TESTING
Donald L. Bartling (M.S. Thesis) Feb. 1967 104 p refs
(Contract AT(11-1)-1624)
(COO-1624-1) CFSTI: HC $3.00/MF $0.65

An Automatic Data Acquisition System for determining the voltage current characteristics of semiconductor devices is presented. The system is capable of measuring currents in the range from 10^{-10} amperes to 200 milliamperes. The system includes various pieces of commercially available equipment plus several pieces of specially designed and fabricated equipment. The system yields a maximum of 59 data points each for both the base and collector characteristics of the transistor tested. The system is designed to perform a particular sequence of events. These events are controlled by a specially designed and fabricated piece of equipment called the control center. The sampling resistance alternately is switched into the base lead and collector lead of the transistor being tested and may have any of nine possible discrete values. An autoranging procedure selects one of the nine possible values using the voltage drop across the sampling resistance as a criterion. Base-emitter bias voltage and collector supply voltage are provided by commercial power supplies. The data are recorded by commercially available equipment and then provided to a computer for the data reduction process which yields the required v/I characteristics. This system is the fifth generation of a system originally developed at Sandia Laboratory. In the present system a cost saving of $9,000 was realized by the use of equipment specially designed and fabricated by the author. In addition, the present system is lighter in weight, more compact, and more versatile than the previous versions. Author (NSA)

N67-29776# Hughes Research Labs., Malibu, Calif.
THREE AND TWO/TENTHS MILLIMETER WAVE OSCILLATOR Quarterly Progress Report, 1 Oct.–31 Dec. 1966
Robert P. Bryan Mar. 1967 22 p ref
(Contract DA-28-043-AMC-02225(E))
(Rept.-6; QPR-1; ECOM-02225-6; AD-650768) CFSTI: HC $3.00/MF $0.65

Progress is reported of the development of a permanent-magnet-focused, 10 kW, pulsed, distributed interaction klystron which oscillates at 93.75 GHz and which has been both environmentally and life tested. Efforts are continuing toward the final design of the permanent-magnet package. The mechanical tuning assembly for the output coupler has been improved, and the electron gun assembly has been made more rugged. Most of the required parts have been received, and construction of the various test vehicles has begun. An experimental tube containing a shorter cavity structure is almost completed. The fabrication has begun of another short pulse modulator needed for the test and evaluation of the tubes. Author (TAB)

N67-29795# Los Alamos Scientific Lab., N. Mex.
COMPUTER DESIGN OF UHF POWER AMPLIFIER TUBES
Donald J. Liska [1966] 16 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-8367; CONF-670307-19) CFSTI: HC $3.00/MF $0.65

Improved computational methods were developed which can reduce the trial and error process in the development of certain microwave power tubes that employ cavities with cylindrical symmetry. It was found, for example, that the application of these computer codes to klystron cavities and internal cavity triodes reveals ways in which their performance can be improved and results in better understanding of experimental results. The computed results agree quite closely with measurements made of such quantities as frequency and operating efficiency. Author (NSA)

N67-29839# Sandia Corp., Albuquerque, N. Mex.
RADIATION EVALUATION OF A SMALL SAMPLE OF FN288 AND SU2105 JUNCTION FIELD EFFECT DEVICES
A. R. Phillips and W. H. Sullivan Dec. 1966 73 p
(Contract AT(29-1)-789)
(SC-RR-66-2664) CFSTI: HC $3.00/MF $0.65

The neutron-induced changes in the electrical properties of four SU2105 and three FN288 field effect devices are described. Data are presented which define the behavior of eight selected electrical parameters at three flux levels ranging from 1.0×10^{13} to 9.5×10^{13} nvt, $E > 0.01$ MeV. In addition, graphs of the drain-to-source V-I characteristics of each device are presented for all flux levels. Author (NSA)

N67-29955# Bell Telephone Labs., Inc., New York.
SEMICONDUCTOR DEVICE AND CIRCUIT TRANSIENT RESPONSE CAUSED BY IONIZING RADIATION
S. C. Rogers [1966] 30 p refs Presented at the Symp. on Radiation Effects on Semiconductor Components, Toulouse
(Contract AT(29-1)-789)
(SC-DC-66-2443; CONF-670303-1) CFSTI: HC $3.00/MF $0.65

An investigation was made on semiconductor and circuit transient response caused by ionizing radiation. Transient responses of diodes and transistors are described qualitatively in terms of carrier generation and movement and quantitatively by theoretical models whose limitations are discussed. The practical aspects of predicting circuit response are considered and a comparison of predicted and measured response is made for a particular circuit. Finally, studies pertaining to the response of monolithic integrated circuits are discussed. NSA

N67-29967# Weapons Research Establishment, Salisbury (Australia).
ELECTRON TRANSPORT IN THE STRONGLY CUT-OFF MAGNETRON
E. H. Hirsch Mar. 1967 12 p refs
(WRE-CPD-125) CFSTI: HC $3.00/MF $0.65

The statistical theory of electron transport through randomly varying electric fields is tested experimentally, and is found to be not applicable in the general case. It is suggested that previously reported experimental agreement with the theory may be due to the masking effect of gas collisions. Within the limits of the theoretical model the results imply that the fields do not vary randomly, but instead are organized in a definite pattern. Author

N67-29990*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A MAGNETIC CORE DIGITIZED SPARK CHAMBER FOR SPACE SCIENCE EXPERIMENTS
C. H. Ehrmann, C. E. Fichtel, D. A. Kniffen, and R. W. Ross Jun. 1967 30 p refs
(NASA-TM-X-55813; X-611-67-267) CFSTI: HC $3.00/MF $0.65 CSCL 09E

A magnetic core digitized spark chamber suitable for use on balloons and ultimately on satellites has been developed. The assembled spark chamber consists of 32 active spark modules and forms the heart of a gamma-ray telescope. The individual modules consist of two orthogonal wire grids which form the spark chamber electrodes. Inclusion of a terminating resistor on each wire localizes the effect of the discharge, resulting in good multiple

spark efficiency at low overvoltages. The lower voltages result in better spatial resolution with fewer wires sharing the spark. In the construction, considerable care was given to strength and long term operation under satellite conditions. The on-board data-handling system consists of a buffered memory readout, a housekeeping multiplexer, a tape recorder, and a telemetry encoder and transmitter. Author

N67-30159*# Giannini Controls Corp., Malvern, Pa. Astromechanics Research Div.
DEVELOPMENT OF AN INFINITE-INPUT-IMPEDANCE FLUIDIC AMPLIFIER
E. Martinez. Jun. 1967 53 p
(Contract NAS12-43)
(NASA-CR-80023) CFSTI: HC $3.00/MF $0.65 CSCL 09C

This report describes the analytical and experimental work carried out during the development of two-phase analog fluidic amplifiers, for infinite input impedance and highly stable gains. Three basic configurations were studied in detail: a buffer (one-to-one) amplifier, a gain amplifier, and a buffer-gain amplifier (which is a variation of the buffer configuration with high gain). In addition, an exploratory chemical investigation was performed to evaluate non-toxic chemical systems to replace the mercury used in the original units. It was found that friction produced significant hysteretic effects in the gain-type amplifier, but had no apparent effect on the other two configurations. The buffer and buffer-gain amplifiers exhibit good linearity. Frequency response experiments on these units showed them to have a bandwidth in excess of 60 hertz. The performance of these two devices is more than adequate for use in many fluidic operational amplifier circuits. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-29027*# Douglas Aircraft Co., Inc., Santa Monica, Calif.
APPLICATIONS OF ARTIFICIAL INTELLIGENCE TECHNIQUES TO A SPACECRAFT CONTROL PROBLEM
J. M. Mendel. Washington, NASA, May 1967 234 p refs
(Contract NAS12-23)
(NASA-CR-755) CFSTI: $3.00 CSCL 22C

The results of a 14 month study of the application of artificial intelligence techniques to a spacecraft control problem are presented. A survey of the present technology of self-organizing control systems and a discussion of potential space-vehicle applications for such systems are presented. Two types of self-organizing (learning) control systems are outlined. A preliminary design of a fine attitude, single-axis controller for an almost cylindrically symmetrical spacecraft that operates in a partially known environment is discussed. The on-line controller designed during the second stage is an on-line learning controller. This controller utilizes the system's past experience in attempting to improve the system's present performance. Learning is accomplished, for the most part, through inclusions of a memory into the on-line controller. The complete design embraces the concepts of stochastic-optimal control theory, combined state and parameter estimation, sensitivity analysis, control situations, on-line cost functions, on-line learning algorithms (error-correcting and reinforcing) and pattern recognition. Author

N67-29087# Air Force Academy, Colo. Frank J. Seiler Research Lab.
LOWER ORDER LINEAR FILTERING AND PREDICTION OF NONSTATIONARY RANDOM SEQUENCES
K. G. Brammer (German Aerospace Res. Organ.) 10 Feb. 1967 37 p refs
(SRL-67-0003; AD-650641) CFSTI: HC $3.00/MF $0.65

The method of Kalman and Bucy for the optimal linear filtering and prediction of nonstationary sample functions has been modified by Bryson and Johansen. They do not require all measurements to contain white noise. The observations without white noise and some of their derivatives are used to reduce the order of the optimal filter. An analogous philosophy is applied here in the discrete time case. The purpose is to specify a lower order optimal filter, in the presence of measurements free of white noise. In a self-contained derivation, the optimal filter is shown to consist of a dynamical part in the form of a difference equation, and a direct algebraic feed-forward path parallel to it. The order of the dynamical part is n-p, where n is the combined number of state variables of the observed signal and noise processes, and p is the number of measurements without white noise. The parameters of the optimal filter are specified by a set of recurrence equations, similar to those of the discrete-time Kalman filter. TAB

N67-29239# Stanford Univ., Calif. Systems Theory Lab.
STEP-UP N-PORT NETWORKS
N. Levan, D. G. Lampard, B. D. O. Anderson, and R. W. Newcomb Jan. 1967 25 p refs
(Grant NSF GK-237)
(SEL-67-004; TR-6558-17; AD-650112) CFSTI: HC $3.00/MF $0.65

The paper presents a method of characterizing n-port networks. It is shown that a large class of lossless n-ports can be characterized by sequences of step-up vectors, i.e., vectors which form successive incident voltages to the networks and which are orthonormal at the same time. As a result, lossless networks can be classified into several classes. The most interesting one is, perhaps, the step-up class which is shown to behave jointly like a unitary operator and a complete step-up operator on seperate subspaces of the space of L sub 2 vectors. Author (TAB)

N67-29240# Stanford Univ., Calif. Systems Theory Lab.
BI-STEP-UP N-PORT
N. Levan, D. G. Lampard, and R. W. Newcomb Jan. 1967 18 p refs
(Grant NSF GK-237)
(SEL-67-005; TR-6558-18; AD-650113) CFSTI: HC $3.00/MF $0.65

The report studies the characterization of a class of nonlossless scattering matrices by means of biorthonormal step-up vectors. It is shown that if any two scattering matrices behave in such a way that one of them is the inverse of the adjoint of the other and such that they preserve inner products in a Hilbert Space, then one can find two sequences of vectors which are biorthonormal and step-up with respect to these scattering matrices. Author (TAB)

N67-29541# Naval Research Lab., Washington, D. C. Energy Conversion Branch.
POWER CIRCUITS FOR OPTIMUM STEPPED-WAVE OUTPUT IN THREE-PHASE SINGLE-WAY STATIC INVERTERS
J. P. O'Connor 6 Mar. 1967 32 p refs
(NRL-6497; AD-650479) CFSTI: HC $3.00/MF $0.65

In the three-phase, single-way inverters considered, the stepped-wave approach offers the great advantage of an output waveform that approaches that of a sinusoid. The single-way type inverter is advantageous where the input dc voltage is low, since in this type of inverter the voltage drop in only one switch need be considered. Fourier analysis of a stepped-wave output shows

that if the center of each step lies on a sinusoid, the lowest harmonic present is one less than the number of steps in the waveform. Various circuit configurations using single-phase and three-phase cores, which involve interconnection of multiple primary transformer windings, are considered for producing stepped waves with minimum harmonic content. These types of circuit configurations result in poor switch and copper utilization, and have limited power capability. Circuit configurations where interconnection of multiple secondary transformer windings are used result in good copper and switch utilization, and the power capability increases as the number of steps (or switches) is increased. If in a multiswitch three-phase inverter one half the total number of switches are considered as one input system and the other half as a second input system, voltage regulation may be obtained by varying the phase relation between the two input systems. For three-phase power applications where the input dc voltage is low, inverter-circuit configurations using interconnection of multiple secondary transformer windings appears attractive. TAB

N67-29592# Bunker-Ramo Corp., Canoga Park, Calif. Defense Systems Div.
PLANAR COAXIAL INTERCONNECTION TECHNIQUES Quarterly Report, 1 Oct.–31 Dec. 1966
Howard L. Parks, William Griff, and Tom Kitaguchi Apr. 1967 108 p
(Contract DA-28-043-AMC-02024(E))
(ECOM-02024-3; F-058; QR-3; AD-648858) CFSTI: HC $3.00/MF $0.65

The primary objectives for this third quarterly period of the planar coaxial interconnection program were to achieve a refinement of the techniques developed thus far in the program and to develop procedures for the fabrication of a planar coaxial vehicle. During this period, emphasis was placed on the applicability of dielectric systems for fabrication requirements; interconnection techniques, including electroless deposition methods; assembly and lamination of mating parts; and electrical testing of completed vehicles. A review of various epoxy systems was made to determine their suitability for the fabrication methods developed. Close examination was made as to such desirable properties as low shrinkage rate, low porosity, high adhesion, application for surface finishing, receptiveness to subsequent electrodeposition, low dielectric constant, low water absorption rate, and other desirable electrical and chemical characteristics. Several avenues of approach were determined and recorded for the fabrication of planar coaxial test vehicles, including step-by-step details of the manufacturing procedure. The quarterly effort was completed with the electrical testing of coaxial vehicles. The data obtained were evaluated in relation to the physical geometry of the units to provide desired direction for future designs. Author (TAB)

N67-30093# National Aerospace Lab., Tokyo (Japan).
SOME CIRCUITS FOR PULSE RATIO MODULATION AND THEIR MODIFIED CIRCUITS
Chikara Murakami Nov. 1966 21 p refs In JAPANESE; ENGLISH summary
(NAL-TR-121; UDC-621.374.3) CFSTI: HC $3.00/MF $0.65

Pulse Ratio Modulation (PRM) seems to be very suitable for linearization of on–off control especially for attitude control of space vehicles. In this report definitions and static characteristics of PRM are first briefly reviewed and then some circuits which satisfy the definitions are presented. PRM has a very close relation to linearizing methods by self-oscillation of feedback circuits which consist of a relay with hysteresis and/or dead time and a first order lag. Linearity is also discussed. After discussion about phase-lead methods of PRM circuits, some modifications are proposed which cause phase-lead effect at low frequency and small amplitude, i.e., these modifications are effective for decreasing limit cycling, and lastly, the effectiveness by analog simulations is illustrated. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-29003*# International Information, Inc., Philadelphia, Pa.
STUDY OF A FAMILY OF DIFFUSERS FOR LOW REYNOLDS NUMBER HYPERSONIC WIND TUNNELS [ETUDE D'UNE FAMILLE DE DIFFUSEURS POUR SOUFFLERIE HYPERSONIQUE A FAIBLE NOMBRE DE REYNOLDS]
B. Monnerie Washington, NASA, Apr. 1967 15 p refs Transl. into ENGLISH from Rech. Aerospatiale (Chatillon-sous-Bagneux), no. 114, Sep.–Oct. 1966 p 9–16
(Contract NASw-1499)
(NASA-TT-F-10876) CSCL 14B

After the advantage of using a diffuser in a low density hypersonic wind-tunnel is demonstrated, a method is proposed for evaluating the overall performance of a family of diffusers consisting of a conical intake followed by a cylindrical mixing section. Results obtained with this system are compared with experimental data, illustrating the effect of various geometrical parameters of the diffuser on the recovery of achievable pressure. Author

N67-29150*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR SPACECRAFT DEVELOPMENT
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 84–86 (See N67-29141 16-34)

A 22-inch air gun for high impact testing the welded steel buttress used to constrain the gun during recoil, and the redwood target are briefly described. Modifications in sabot design and the instrumentation are mentioned. N.E.N.

N67-29169*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESCRIPTION AND DESIGN OF LIQUID-METAL RADIATOR AND CONDENSER TEST FACILITY
Loren W. Acker, Nick J. Sekas, and Seymour Lieblein Washington, NASA, Jun. 1967 98 p refs
(NASA-TM-X-1398) CFSTI: HC $3.00/MF $0.65 CSCL 10B

A facility for research on multitube liquid-metal space radiators and condensers was designed for potassium vapor generation at temperatures up to 1800°F, with a heat-rejection rate of 150 kilowatts. A capability was provided for testing multitube NaK-cooled condensers, radiation-cooled vapor radiators (direct condensing), or radiation-cooled liquid-flow radiators (indirect condensing). Radiation cooling was obtained with an 8-by-18 ft oil-cooled vacuum chamber. The principal test components (boiler, condenser, and radiator) were horizontally-oriented to minimize the effects of gravity. A discussion of the principal design features of the liquid-metal radiators and condenser test facility is presented. An overall description of the facility is given, including cycle considerations, general facility specifications and layout, and descriptions of the heating, vapor, and cooling loops. This description is followed by a presentation of detailed design considerations and descriptions of the various components. Included are loop piping, oxide control and indicating systems, vacuum chamber, loop pressurization and vacuum-pumping systems, and instrumentation. The detailed design specifications submitted for the construction of the facility are also included. Author

N67-29171*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
LOW GRAVITY SIMULATION BY HIGH ALTITUDE DROP TESTING

Frank Bugg 15 May 1967 31 p refs
(NASA-TM-X-53608) CFSTI: HC$3.00/MF$0.65 CSCL 14B

Continuous low gravity test times of 24 to 26 seconds were achieved with a maximum drag shield velocity of 820 ft/sec. Thrust applied to the drag shield opposing the drag force was required to limit the travel of the experiment package relative to the shield. Application of a constant thrust for the duration of a drop, application of a thrust increasing at a constant rate, and delayed application of a constant thrust were studied. The latter two thrust methods gave longer test times with shorter drag shield required. In some cases, 22 to 24 seconds of low gravity test time were indicated with a drag shield which allowed 15 feet of longitudinal travel of the experiment package relative to the shield. The effects of changes in longitudinal aerodynamic stability and wind profile on the drag shield and experiment package dynamics were also studied. A wide range of values for the stability parameter was found to be acceptable. The lateral motion of the experiment package relative to the drag shield was less than one-half foot for the most severe conditions of wind and aerodynamic stability investigated. Author

N67-29194# Societe National d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
SIMULATOR RIG FOR REGULATION OF A TWIN-SPOOL BYPASS REACTOR WITH REHEAT [BANC SIMULATEUR POUR REGULATION D'UN REACTEUR DOUBLE CORPS, DOUBLE FLUX A POST-COMBUSTION]
A. Ravagli *In* AGARD Gas Turbines 1966 p 275–288 In FRENCH; ENGLISH summary (See N67-29181 16-28)

This simulator rig makes it possible to study the dynamic operation of a full-scale fuel control system associated with an analog computer reproducing transient operating conditions of twin-spool by-pass turbo-jet engine with re-heat. Controls are fed with oil or fuel by pumps driven at a constant mean speed, and pick-offs measure the fuel flow and the position of a nozzle simulator jack. These parameters are fed into the computer, which formulates the control parameters (speed of rotation, compressor pressures etc.) as a function of certain selected values typical of flight conditions simulated. In its current configuration, the simulator rig makes it possible to study the dynamic operation around a steady operating position if magnitude of variation of various parameters is sufficiently low to maintain the linearization assumptions. A second development step, which is being pursued, will extend the capacity of this rig to the study of large power setting variations (acceleration–deceleration). Author

N67-29328# Sandia Corp., Livermore, Calif.
HAZARDOUS MATERIALS HANDLING FACILITY
C. Calder and R. O. Campbell Feb. 1967 16 p Presented at 84th Conf. on Methods in Air Pollution and Ind. Hyg. Studies, Oakland, Calif.
(Contract AT(29-1)-789)
(SCL-DC-67-5; CONF-670204-1) CFSTI: HC$3.00/MF$0.65

A centralized facility for both wet and dry operations with hazardous materials at atomic research facilities is described in which: personnel exposure to hazards is greatly reduced; wet effluent is confined and contained; holding tank agitation provides reliable representative sampling; dry contaminants are enclosed and captured; simplified HEPA filter mounting and sealing system decreases handling and disposal problems; operational procedures may be standardized, thus yielding improvements in both administrative and material control; and supervisory requirements are minimized. Experience with both the wet and dry operations has demonstrated that the personnel protective features function as intended, and basic changes are unnecessary. Author (NSA)

N67-29334# Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany).
BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. SECTION 16: ACCELERATORS
W. Mausberg, comp. Nov. 1966 122 p
(AED-C-16-07) CFSTI: HC$3.00/MF$0.65

A bibliography of 432 references on various aspects of particle accelerators is presented. Included also are author, patent, report number, and subject indexes. NSA

N67-29395# Texas A&M Univ., College Station.
POTENTIALITIES OF AN 88 INCH VARIABLE ENERGY CYCLOTRON FOR CHARGED PARTICLE ACTIVATION ANALYSIS
M. Y. Cuypers *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 81–96 refs (See N67-29389 16-24)

Summarized are results of a literature survey of methods and research reported in the field of charged particle activation analysis using a cyclotron, and results of an analysis of theoretical and methodological approaches to planned experiments. Also outlined is the scope of future work in charged particle activation analysis and a tentative schedule of the plans for future experiments. S.C.W.

N67-29460# Wilcox Electric Co., Inc., Kansas City, Mo.
FEASIBILITY OF AREA MAINTENANCE CONCEPT WITH SELF-CONTAINED TEST VEHICLE FOR USE ON LOW COST INSTRUMENT LANDING SYSTEM Final Report
David Staehling Dec. 1966 129 p refs
(Contract FA-65-WA-1272)
(RD-66-104; AD-651026) CFSTI: HC$3.00/MF$0.65

The report presents the results of a study to determine how a test vehicle might be used to accomplish on-site periodic maintenance on Low Cost ILS equipment. The chief purpose of the vehicle would be to transport test equipment and unit spares to the site in conjunction with the secondary purpose of providing shelter during maintenance. The transportation aspect (area maintenance) was explored in detail. ILS candidate airports were plotted on a map, and a sample maintenance area was studied from a simulated maintenance schedule. It was concluded that the area maintenance system is highly advantageous and should be implemented as soon as an ILS design for this type of maintenance is available. The report includes specifications and guidelines for development of a Low Cost ILS System which is compatible with the area maintenance concept. Author (TAB)

N67-29545# Library of Congress, Washington, D. C. Aerospace Technology Div.
SUPPORT FACILITIES AND EQUIPMENT FOR MISSILE AND SPACE SYSTEMS. Surveys of Foreign Scientific and Technical Literature, 1 Oct.–31 Dec. 1966
Victor Klein 20 Feb. 1967 19 p refs *Its* Work Assignment No. 13
(ATD-67-12; Rept.-21; AD-649846) CFSTI: HC $3.00/MF $0.65

The compilation of abstracts is the 21st report in a series (formerly titled Protective Structures and Components) on support facilities and equipment for missiles and space systems. The report includes data on techniques for Arctic and permafrost areas, road construction methods, new construction of main and branch railroad lines, railroad construction techniques, construction materials, description of a floating harbor crane, and transportation of containerized goods by tractor trailer trains. Appended to the text are 7 photographs and diagrams which are cited in the foregoing entries. A bibliography of 14 entries is included. TAB

N67-29697# Los Alamos Scientific Lab., N. Mex.
ADVANCES IN THE DESIGN OF PROTON LINEAR ACCELERATORS: MESON FACTORIES AND INJECTORS FOR SYNCHROTRONS

Daragh E. Nagle [1966] 8 p refs Presented at the Natl. Particle Accelerator Conf., Washington, D. C.
(Contract W-7405-ENG-36)
(LA-DC-8383; CONF-670307-12) CFSTI: HC $3.00/MF $0.65

Some of the worldwide projects to build new linear accelerators are reviewed. Topics include ion sources, beam transport, longitudinal motion, and accelerator structures. NSA

N67-29760# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
STABILITY OF MODULATED BEAM IN A DISK-LOADED WAVEGUIDE [USTOICHIVOST MODULIROVANNOGO PUCHKA V VOLNOVODE, NAGRUZHENNOM DISKAMI]
V. I. Kurilko 1966 14 p refs In RUSSIAN
(Rept.-255/T-041; NP-16567)

The instabilities which lead to the collapse of the charged-particle current in linear accelerators are caused by the excitation of nonaxial-symmetric oscillations of the accelerating system, such as the disk-loaded waveguide. The growth increment of the instability was examined for the case of a modulated beam in a disk-loaded waveguide, without limitation as to the length of the section, the current, and the ratio of the resonance and modulated frequencies. The calculations revealed that beam modulation causes an increase of the threshold current only under the condition of $\delta << \Gamma, \gamma$, whereby δ is the frequency difference, Γ the attenuation decrement, and γ the growth increment. For a given current, the depth of modulation does not affect the growth increment of the instability. In case of lack of matching with the frequency of the defocusing oscillation, the instability becomes absolute and the field increases exponentially with time in any point of the section. Reduction of the threshold current results in an increase of the number of sections, probably because upon leaving the first section, the frequency of the defocusing oscillation becomes modulated; in the subsequent sections the modulation will be amplified because of the excitation of defocusing oscillations. NSA

N67-29805# California Univ., Livermore. Lawrence Radiation Lab.
DESIGN OF AXIALLY SYMMETRIC ELECTRON GUNS
Jack W. Beal 30 Jan. 1967 6 p refs Presented at the Natl. Particle Accelerator Conf., Washington, 1–3 Mar. 1967
(Contract W-7405-ENG-48)
(UCRL-70199; CONF-670307-9) CFSTI: HC $3.00/MF $0.65

In the design of high-perveance electron beam devices, it is necessary to evaluate the effects of the self-fields on the beam trajectories as well as the effects of any external electromagnetic fields that may be present. A means whereby the self-consistent solution of Poisson's equation, the relativistic equations of electron motion, and the equation of charge continuity all subject to specified boundary conditions, are determined by means of a digital computer program, is described. In particular the method is applied to the case of an axially symmetric, solid-beam electron gun where the electrons are emitted with zero initial velocity from a space-charge-limited cathode. NSA

N67-29808# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Nuclear Engineering and Science.
LINEAR ACCELERATOR PROJECT Progress Report, Oct.–Dec. 1966
Dec. 1966 125 p refs
(Contract AT(30-3)-328)
(TID-23685) CFSTI: HC $3.00/MF $0.65

Research on fast-neutron spectra continued with studies of electron beam targets for neutron sources and of the efficiency of proton-recoil detectors for spectral measurements. Computer programs were also written for the calculation of fast-neutron spectra. Neutron capture yields were measured for Al, Fe, Ni, and Na; and neutron resonance scattering by ^{104}Rh at low energy was investigated. Neutron resonance capture in Fe and Ni was studied using a self-indication detection method. The development of a spark chamber for detecting ^{239}U fission fragments continued with emphasis on a different configuration. Measurements were also made of the spatial distribution of 4.9-eV neutrons in light water, time-dependent neutron spectra in light water, and time-dependent spectra as functions of material, buckling, absorption, and temperature; and a dual-disk neutron chopper with pulse widths of 1.8 and 3.6 μsec (full width at half maximum) was designed. Differential cross sections for neutron scattering by polyethylene at 0.33, 0.65, and 1.02 eV were measured. The research on transient radiation effects in Si irradiated with 50-MeV electrons was completed, and the effects of 48-MeV electrons on heavily doped Si were investigated. NSA

N67-29813# National Inst. for Research in Nuclear Science, Harwell (England). Variable Energy Cyclotron Group.
BEAM MEASUREMENTS DURING THE COMMISSIONING OF THE HARWELL VARIABLE ENERGY CYCLOTRON, DECEMBER 1965–AUGUST 1966
J. R. J. Bennett, J. H. Coupland, E. J. Jones, J. D. Lawson, A. R. Mayhook et al Dec. 1966 30 p refs
(RHEL/R-135) CFSTI: HC $3.00/MF $0.65

The performance of the Harwell VEC during the first nine months of operation is described. The various diagnostic techniques employed, and their relative value in setting up the machine and assessing its performance are discussed. Some typical measurements are presented, with a discussion of the problems of their evaluation and interpretation. The period covered was mainly occupied by internal beam studies, before the deflector was installed, but the first measurements of the extracted beam are also included. Author (NSA)

N67-29888# Aeronautical Research Council (Gt. Brit.)
A MOVING-BELT RIG FOR GROUND SIMULATION IN LOW-SPEED WIND TUNNELS
S. F. J. Butler, B. A. Moy, and T. N. Pound London, HMSO, 1967 23 p refs Supersedes RAE-TN-AERO-2937; ARC-25874; see X64-14102
(ARC-R&M-3451; RAE-TN-AERO-2937; ARC-25874) CFSTI: HC $3.00/MF $0.65

This note describes the design and development of a moving-belt rig affording an 8-ft-wide belt capable of speeds up to 90 fps. Boundary layer profiles close to the moving surface are discussed, together with the effects of the presence of the rig on the mainstream velocity distribution in the tunnel working section. In order to assess the importance of the incorrect boundary layer development with the stationary groundboard, the rig has been used for comparative tests on a series of representative models. The current experience with these models is considered in relation to future test requirements, to facilitate the testing of round-jet V/STOL models. Author

N67-29899# Aeronautical Research Council (Gt. Brit.)
DESIGN AND OPERATING FEATURES OF THE N.P.L. 6 IN. SHOCK TUNNEL
L. Pennelegion, R. F. Cash, and D. F. Bedder London, HMSO, 1967 50 p refs Supersedes NPL-AERO-1140; ARC-26521; see X67-18396
(ARC-R&M-3449; NPL-AERO-1140; ARC-26521) HMSO: 18s 6d

The design and operating features of a 6-inch shock tunnel facility are described. The tunnel was designed primarily for operation with driver gases at room temperature and consists of a high pressure driver section, interchangeable nozzles, and a constant area working section with an added dump chamber. Details of gas services and routine instrumentation are given. The performance envelope of the tunnel is discussed and routine measurements are presented. R.N.A.

N67-29927# National Aerospace Lab., Tokyo (Japan).
DESIGN AND CONSTRUCTION OF THE 50CM HYPERSONIC WIND TUNNEL AT NATIONAL AEROSPACE LABORATORY
Mar. 1966 69 p refs In JAPANESE; ENGLISH summary
(NAL-TR-116)

Design and construction are described for an intermittent blow-down type 50 cm hypersonic wind tunnel, whose air supply of 200 kg/cm^{2}G is obtained by a system consisting of a compressor, driers, and high pressure vessels having a total volume of 12 m^3. Four interchangeable solid axisymmetric nozzles, with nominal Mach numbers of 5, 7, 9, and 11, are available; and vacuum pumps and a tank permit a vacuum-driven operation. The high pressure air can be heated up to 1000°C by an aluminum oxide pebble-bed heater. A computer and a digital data handling system are used with the wind tunnel. M.W.R.

N67-29951# Uppsala Univ. (Sweden).
THE 100/135/300 CM SCHMIDT TELESCOPE AT THE UPPSALA OBSERVATORY KVISTABERG STATION
Ake Wallenquist Repr. from Nova Acta Regiae Soc. Sci. Upsaliensis, Ser. 4, v. 19, no. 2, 1967 p 1–19 refs
CFSTI: HC $3.00/MF $0.65

Design and construction of the telescope are described in detail. Instrumental optics consist of a borosilicate mirror with a diameter of about 135 cm at a thickness of 23 cm and a central hole 30 cm in diameter; its corrector plate disk of 101 cm diameter transmits a fair amount of UV light with the neutral zone situated about 400 mm from the central line. The Schmidt telescope incorporates also an objective prism with a diameter of 80 cm and a refracting angle of 7°. The objective grating of 2 mm thick round bars of stainless steel can be used alone or together with the objective prism and has a photometric grating constant of 1.00 ± 0.02 magn. Several star spectra, obtained with this instrument, are shown. G.G.

N67-29954# Stanford Univ., Calif. Linear Accelerator Center.
SYSTEMS FOR THE HUMMINGBIRD AT SLAC
C. Dickens Jan. 1967 10 p refs Presented at the Intern. Conf. on Flying Spot Devices at the Max Planck Inst., Munich, 18–20 Jan. 1967
(Contract AT(04-3)-515)
(SLAC-PUB-255; CONF-670105-1)

The building and subsequent incorporation into the IBM 360/50 system of the Hummingbird I Scanner are discussed. Topics included are general description, basic program organization, basic programming control, basic output and I/O interface. Additional projects are also included: CBX system, N-P system, and on-line SUMX. NSA

N67-29963# Royal Aircraft Establishment, Farnborough (England).
PROPOSAL FOR A SHOCK-TUBE FACILITY TO SIMULATE SONIC BANGS
C. H. E. Warren Nov. 1966 18 p refs
(RAE-TR-66344)

The use of a shock-tube facility to simulate sonic bangs for the study of their effects is proposed. The basic philosophy of such a facility is propounded from theoretical considerations, substantiated by some pilot experimental studies. It is suggested that a detailed design of a facility based on the proposals should now be made. This will require the solution of a number of technical problems, which are listed. Author

N67-30021*# College of William and Mary, Williamsburg, Va.
A STUDY OF PION AND MUON BEAM TRANSPORT SYSTEMS FOR A 600 MeV SYNCHROCYCLOTRON Semiannual Status Report, 6 Aug. 1966–6 Feb. 1967
Herbert O. Funsten 6 Feb. 1967 4 p
(Grant NsG-636)
(NASA-CR-66410) CSCL 20G

Continued research focusing on the design of a flexible mounting facility for the pion–muon channel for the 600 MeV synchrocyclotron, and the determination of channel performance, is reported. Presented are data on magnet specifications and fabrication; the mechanical design of the channel mounting structure; the properties of an infinite focusing channel with successive quadrupole rotations not equal to 90°; negative pion beam testing; and the development of scintillation counter instrumentation for the detection of both positive and negative pion fluxes. S.C.W.

N67-30082# National Aerospace Lab., Tokyo (Japan).
ANALYTICAL AND SIMULATION STUDIES ON THE ATTITUDE CONTROL SYSTEM OF THE FLYING TEST BED
Shun Takeda, Yuso Horikawa, Toshio Ogawa, and Mikihiko Mori Nov. 1966 43 p refs In JAPANESE; ENGLISH summary
(NAL-TR-120; UDC-629.13)

The capabilities of the lift-jet VTOL aircraft on VTOL operations, were tested, and analytical and simulation studies were carried out on the attitude control system of the Flying Test Bed (FTB). With low aerodynamic damping, the hovering characteristics of a VTOL aircraft are very poor. This report outlines the synthesis and design problems of Automatic Stabilization Equipment (ASE) for FTB. ASE has two main functions, cancelling the engine gyroscopic moment, and giving the vehicle damping and stiffness forces. These control moments are generated by reaction jets. The sensors are only vertical gyros and the angular rate signals are obtained through derivative circuits. To improve the reliability of ASE system and to overcome malfunctions caused by some failures in its parts, it is redundantly triplexed. Stability of over-all system was studied by the root-locus method, and the design parameters, such as optimum gains, were determined by simulation tests. It was assured that the handling qualities not less satisfactory than those for helicopters can be gained with this ASE system. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-28005*# Scientific Translation Service, La Canada, Calif.
THE HYDRODYNAMIC RESISTANCE OF A DISK [O GIDRODINAMICHESKOM SOPROTIVLENII DISKA]
V. M. Kapinos Washington, NASA, May 1967 7 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR Energ. i Transp. (Moscow), no. 5, Sep.–Oct. 1965 p 155–158
(Contract NASw-1496)
(NASA-TT-F-10930) CSCL 20D

An exact solution is given of the problem of flow around a disk that rotates in a closed housing. This solution is carried out within the framework of the theory of a boundary layer of finite thickness. Expressions are obtained for the peripheral friction stresses and the friction-resistance moments on the disk and the housing. By equating the expressions for the resistance moments of the disk and the housing, an equation for determining the twist of the flow core is obtained. A formula for determining the coefficient of the resistance moment is obtained from a study of the dependence of this coefficient on the relative gap between the disk and the housing. Author

N67-29042# Aix-Marseilles Univ. (France).
STRUCTURE OF VELOCITY SPACE-TIME CORRELATIONS IN A BOUNDARY LAYER. ANALYTICAL EXPRESSIONS OF SPACE-TIME CORRELATIONS CELERITIES. FACILITIES AND METHODS OF MEASUREMENT FOR TEMPERATURE SPACE-TIME CORRELATIONS IN A BOUNDARY LAYER
A. J. Favre, R. Dumas, J. Gaviglio, and E. Verollet Jan. 1967 34 p refs
(Contract AF 61(052)-772)
(ASR-3; AFOSR-67-0892; AD-650405) CFSTI: HC $3.00/MF $0.65

The equations for space-time velocity correlations are given in the case of statistical homogeneity in time. The equations are written in terms of celerities, some properties of which are discussed. Facilities and methods of temperature and velocity space-time correlation in a thermal boundary layer are described; for this purpose a fluctuation diagram is used. Author (TAB)

N67-29057# Mechanical Technology, Inc., Latham, N. Y.
ELASTOHYDRODYNAMIC THEORY OF SPHERICAL BODIES IN NORMAL APPROACH MOTION
Helge Christensen 24 Apr. 1967 46 p refs
(Contract N00014-66-C-0037)
(MTI-67TR21; AD-651154) CFSTI: HC $3.00/MF $0.65

The elastohydrodynamic problem of normal approach of two spherical bodies is studied and the lubrication and elasticity equations governing this type of motion are established. Numerical solutions to the general case accounting for elastic deformation of the bodies and pressure dependent viscosity are presented. Author (TAB)

N67-29073# California Univ., Berkeley. College of Engineering.
VECTOR POLAR METHOD FOR THE ANALYSIS OF WAVE INTERSECTIONS
A. K. Oppenheim and J. J. Smolen Nov. 1966 56 p refs
(Grant AFOSR-129-67)
(AS-66-16; TN-1-67; AFOSR-67-0850; AD-650320) CFSTI: HC $3.00/MF $0.65

Vector polar method is a graphical technique for the solution of wave interaction problems that are concerned with overall results, rather than with the progress of the process. The paper describes the application of this method to wave intersections, that is interactions in steady flow. The fundamental concepts for the method are developed from basic principles, and its use is illustrated by a number of multi-wave intersection processes, including triple front intersections and their reflections. Author (TAB)

N67-29090# General Electric Co., Philadelphia, Pa.
HYPERSONIC DYNAMIC STABILITY. PART III: UNSTEADY FLOW FIELD PROGRAM Final Report, May 1963–Jun. 1964
H. Rie, E. A. Linkiewicz, and F. D. Bosworth Wright-Patterson AFB, Ohio, AF Flight Dynamics Lab., Jan. 1967 306 p refs
(Contract AF 33(657)-11411)
(FDL-TDR-64-149, Pt. III; AD-650879) CFSTI: HC $3.00/MF $0.65

A method of computing static and dynamic force and moment coefficients was prepared. The method provides for a complete inviscid flow field solution to be computed on the IBM 7094 machine. The solution provides values of all pertinent flow field parameters at a large number of points in the shock layer surrounding a pointed or spherically blunted body of revolution (or the analogous two-dimensional shapes) in supersonic or hypersonic flight. Perturbations (of each flow field parameter) due to angle of attack, rate of change of angle of attack, and pitch velocity are also computed. The force and moment coefficients are obtained by integrating the appropriate perturbations in pressure over the body surface. The above flow field capabilities were delivered in the form of magnetic tapes. A sample solution was demonstrated on the Wright-Patterson AFB computer installation on June 30–July 1, 1964. The analysis and programming of this solution is described. Author (TAB)

N67-29095# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
CALCULATION OF THE LAMINAR BOUNDARY LAYER ALONG THE GENERATING LINE OF A SUBLIMATING BODY OF REVOLUTION
V. V. Shchennikov 23 Feb. 1967 11 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 5, no. 1, 1965 p 139–144
(Contract NOw-62-0604-c)
(TG-230-T517; TT-67-61535; AD-650397) CFSTI: HC $3.00/MF $0.65

A method is outlined for constructing finite-difference schemes to be used in calculating a laminar boundary layer on the basis of the laws of conservation. Examples are given of calculations of a boundary layer on a sublimating sphere, without taking chemical reactions into account. The effect of sublimation on the heat flux to the body is estimated. At the end of the article a method is given for constructing difference schemes by means of integral relations. Author (TAB)

N67-29121# Naval Ordnance Lab., White Oak, Md.
CHARACTERISTICS OF THE TURBULENT BOUNDARY LAYER WITH HEAT AND MASS TRANSFER: DATA TABULATION
James E. Danberg 23 Jan. 1967 55 p refs
(NOLTR-67-6; AD-650272) CFSTI: HC $3.00/MF $0.65

A tabulation of turbulent boundary layer data obtained under conditions of heat and mass transfer at a Mach number of 6.7 is presented. The report supplements the treatise given in NOLTR 64-99 (AD-452 471). A brief description of the model and test procedure is included. TAB

N67-29135# Aix-Marseilles Univ. (France). Inst. of Statistical Mechanics of Turbulence.
STRUCTURE OF VELOCITY SPACE-TIME CORRELATIONS IN A BOUNDARY LAYER
A. Favre, J. Gaviglio, and R. Dumas [1966] 36 p refs Presented at the IUGG-IUTAM Symp. on Boundary Layers and Turbulence Including Geophys. Appl., Kyoto, Japan, 19–24 Sep. 1966
(Contract AF 61(052)-772)
(AFOSR-67-0860; AD-650292) CFSTI: HC $3.00/MF $0.65

Space-time correlations of the longitudinal velocity fluctuations have been measured in a turbulent boundary layer, with and without frequency filtering. Celerities, relative to various fluctuation scales, are defined as partial derivatives of the isocorrelation curves with respect to both space separation and time delay. An example of introducing these celerities into the equations of motion is given for a simple case. The variation of these celerities with respect to fluid velocity is examined as function of fluctuation scales and of distance to the wall. As a complement to the study of the effect of longitudinal space separation, the effect of a space separation orthogonal to the wall has been determined, for various filtering frequencies, with regard to optimum time delay and the maximum value of the correlation coefficient. TAB

N67-29160*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLUID PHYSICS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 241–250 refs (See N67-29141 16-34)

A simple, closed mathematical system of integro-differential equations is developed for a kinetic collision model of gas mixtures. The formulation of the kinetic model, and the conservation laws

and relaxation properties are considered. A discussion is also presented on the flow creating a concentration of vorticity over a stationary plate, as in the interaction of a tornado with the ground, is also discussed. Among the conclusions are the following: Boundary layer flow calculations based on measured tangential velocity profiles of swirling flow do not agree with direct measurements. The discrepancy can be corrected by assuming an intense local meridional flow impressed on the boundary layer material, which, as it approaches the center of rotation, erupts to produce the intense meridional circulation. The strength of the vortex is dependent on the history of the boundary layer, thus pointing to possible control of tornadoes by disturbing the boundary layer at the ground. N.E.N.

N67-29165*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ATTACHED AND SEPARATED BOUNDARY LAYERS ON HIGHLY COOLED, ABLATING AND NONABLATING MODELS AT M = 13.8

Donald M. Kuehn and Daryl J. Monson Washington, NASA, Jun. 1967 66 p refs

(NASA-TN-D-4041) CFSTI: $3.00 CSCL 01A

Separated and attached flows were studied on ablating and on nonablating models at M = 13.8. Two types of axisymmetric models were tested: cylinder-flare models with conical and hemispherical noses and bluntfaced base-flow models. The boundary layers on these highly cooled models were generally laminar, but in a few cases appeared to have been transitional. Nonablating models were used to study effects of Reynolds number and model geometry on separation and to examine incipient separation conditions at low Reynolds numbers. Effects of ablation were determined by comparison of experimental data from ablating and nonablating models. The two most significant results for the nonablating models were associated directly with the very low Reynolds number of the tests. Large turning angles with no separation were observed for the thick, highly cooled laminar boundary layers. The present experiments show that as Reynolds number decreases the extent of laminar separation also decreases. The second phenomenon associated with this low Reynolds number was the merging of the viscous layer and shock wave. Ablation influenced surface pressures and boundary-layer transition in some cases, but generally had very little influence on the extent of laminar separation. Author

N67-29166*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

ANALYSIS OF RADIATIVE HEAT TRANSFER FOR LARGE OBJECTS AT METEORIC SPEEDS

Kenneth K. Yoshikawa Washington, NASA, Jun. 1967 116 p refs

(NASA-TN-D-4051) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An explicit closed-form solution was obtained for radiative heat transfer to a body in flight in the earth's atmosphere at speeds such that radiation is the dominant mode of heat transfer. The solution was attained by assuming a grey-gas radiator and then linearizing the radiative transfer equation. Approximations to the one-dimensional flow equations are developed which allow the solution to be applied to the stagnation region of a shock layer on an axisymmetric body. The linearized solution is readily applicable to multilayer heat transfer encountered during very high speed flights, when the interactions among the cold air ahead of the shock wave, the heated air behind the shock wave, and the layer of ablation gases adjacent to the body surface must be considered. The development of the solution is described, and applications are discussed. The results demonstrate the effects, on radiative and convective heat transfer to the body surface, of shock layer energy loss by radiation, absorption of radiation within the multiple layers, blockage of radiative heating by blowing of ablative vapors, and the absorption and emission of radiation by the body. Author

N67-29259*# Princeton Univ., N. J.

SIMULATION OF GASEOUS CORE NUCLEAR ROCKET MIXING CHARACTERISTICS USING COLD AND ARC HEATED FLOWS

Peter M. Williams and Jerry Grey Washington, NASA, Jun. 1967 159 p refs

(Contract NASr-216)

(NASA-CR-690) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Mixing phenomena of cold and arc heated jets of one and two centimeters in diameter exhausting into coaxial flows of helium or nitrogen were investigated over ranges of (1) jet temperatures between room and 9000°R, (2) jet Reynolds numbers between 10 and 10^4, and (3) coaxial to jet velocity ratios from 0 to 780. Velocity, temperature, and composition profiles were obtained at the jet exit plane and downstream locations of 1/2, 1, and 2 jet diameters at a total of 47 different flow conditions, including three variations of the coaxial flow injection scheme. Experimental data, correlated with the separation ratio for the two streams, show a consistent agreement for the effects of velocities, temperatures, Reynolds numbers, molecular weights, and an exit plane mixing factor. The mixing processes were strongly dominated by an apparent wake phenomena at the exit plane, and could not be described by an empirical application of the arcjet mixing theory. Author

N67-29319*# National Aeronautics and Space Administration, Washington, D. C.

APPLICATION OF THE CHARACTERISTICS METHOD TO NUMERICAL SOLUTION OF UNIDIMENSIONAL PROBLEMS IN GAS DYNAMICS

A. I. Zhukov Jun. 1967 159 p refs Transl. into ENGLISH of the book "Primeneniye Metoda Kharakteristik k Chislennomu Resheniyu Odnomernykh Zadach Gazovoy Dinamiki" Moscow, Izd. AN SSSR, 1960 149 p

(NASA-TT-F-298) CFSTI: $3.00 CSCL 20D

Gas dynamic equations are derived for the motion of an ideal, compressible gas, based on the assumption that all quantities depend on one coordinate and time. The equations of characteristics and the invariants are treated, and the theory underlying the practical methods used to determine the flow field is discussed. The order of accuracy of the initial calculation based on linear interpolation, and the recalculation based on quadratic interpolation are outlined. Practical formulas are derived for several equations of state. Methods of computing the boundary conditions in the flow field are described, and several examples of simple waves for which one of the Riemann invariants is constant are presented. Based on the laws of conservation, jumps in the flow parameters across line discontinuities are formulated. Attention is also focused on the spontaneous formation of shock waves which is related to the phenomena of intersection of similar characteristics. The difficulties involved in programming the characteristics method are assessed, and several computer programs are discussed. M.G.J.

N67-29355*# International Information, Inc., Philadelphia, Pa.

SUPERSONIC GAS FLOW AROUND BLUNT BODIES—THEORETICAL AND EXPERIMENTAL INVESTIGATIONS

O. M. Belotserkovskiy, ed. Washington, NASA, Jun. 1967 324 p refs Transl. into ENGLISH of the book "Obtekaniye Zatuplennykh tel Sverkhzvukovym Potokom Gaza. Teoreticheskoye i Eksperimental'noye Issledovaniya" Moscow, Computer Center of the Acad. of Sci. USSR, 1966

(Contract NASw-1499)

(NASA-TT-F-453) CFSTI: HC $3.00/MF $0.65 CSCL 01A

This review deals with certain characteristics of using the method of integral relations for the solution of the mixed problem of supersonic flow around blunt bodies, describes the construction of the numerical algorithms, and demonstrates their use for various cases of flow. Many calculations of two-dimensional and three-dimensional bodies of different shapes are included.

Investigations were made of an ideal gas with constant values of heat capacities and flows with equilibrium and nonequilibrium dissociation, ionization, vibrational-dissociation relaxation, and radiation. Viscous gas flows were calculated, and are presented in the form of tables and graphs. Supersonic flow around blunt bodies was also studied experimentally, and a comparison of the calculated and the experimental data is presented. Author

N67-29453# Brown Univ., Providence, R. I. Div. of Applied Mathematics.
KNUDSEN FLOWS THROUGH LONG CAPILLARIES
Y. P. Pao and Jeanne Tchao Oct. 1966 17 p ref
(Contract Nonr-562(39))
(Nonr-562(39)/9; TR-9; AD-649837) CFSTI: HC $3.00/MF $0.65

Contents: The Clausing integral equation; The Wiener-Hopf method; Analysis of K(u) and G(u) as u approaches 0 and u infinity; The non-homogeneous Hilbert problem; The solution. TAB

N67-29456# Princeton Univ., N. J. Gas Dynamics Lab.
RESEARCH ON PROBLEMS OF HIGH SPEED GAS DYNAMICS Final Report, 15 Nov. 1965–15 Sep. 1966
S. M. Bogdonoff Wright-Patterson AFB, Ohio, ARL Nov. 1966 22 p refs
(Contract AF 33(615)-3328)
(ARL-66-0232; AD-651114)

A series of fundamental studies was conducted, mostly concentrated in the areas of flows at high Mach number under rarefied conditions but including separated flows and other fundamental fluid mechanical problems. Both experimental and theoretical investigations have been carried out. Brief reviews of the completed works as well as outlines of the studies still in process are included along with a complete listing of all publications and papers generated by the research. Author (TAB)

N67-29496# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
UNSTEADY PROPELLER LIFTING-SURFACE THEORY WITH FINITE NUMBER OF CHORDWISE MODES Final Report
S. Tsakonas, W. R. Jacobs, and P. H. Rank, Jr. Dec. 1966 127 p refs
(Contract Nonr-263(55))
(R-1133; AD-649616) CFSTI: HC $3.00/MF $0.65

A continuing investigation is concerned with improvement of the mathematical model developed for the evaluation of the steady and time-dependent loading distributions on the blades of marine propellers operating in spatially non-uniform flow. The surface integral equation resulting from the theory was solved by means of the collocation method, in conjunction with the generalized lift operator, for a prescribed set of chordwise modes which reproduce the proper leading-edge singularity and fulfill the Kutta condition at the trailing edge. General programs were developed to accommodate any geometry of propeller operating in a specified non-uniform inflow condition for a large but finite number of chordwise modes. The calculations indicate that the spanwise loading distribution and the steady and time-dependent thrust reach stable values after three to five chordwise modes, but the chordwise distribution does not converge to its final form, particularly in the neighborhood of the leading and trailing edges. A comparison of theoretical and experimental results for the vibratory thrust shows satisfactory agreement on the whole. Author (TAB)

N67-29531# Advisory Group for Aerospace Research and Development, Paris (France).
SEPARATED FLOWS. A ROUND TABLE DISCUSSION
Jean J. Ginoux, ed. May 1966 28 p Presented at AGARD Specialists Meeting on Separated Flows, Rhode-Saint-Genese, Belgium, 10–13 May 1966
(AGARD-548) CFSTI: HC $3.00/MF $0.65

A round table discussion on various topics related to separated flows is presented, including discussions of the following: steadiness of separation and reattachment, the validity of the boundary layer equations for problems of separation and reattachment, current investigation on the turbulent mixing coefficient, reattachment problems, and the effect of Reynolds number on base pressure. L.E.W.

N67-29532# Advisory Group for Aerospace Research and Development, Paris (France).
THE PITOT PROBE IN LOW DENSITY PROBE
S. A. Schaaf (Calif. Univ., Berkeley) Jan. 1966 28 p refs Submitted for publication
(AGARD-525) CFSTI: HC $3.00/MF $0.65

The measurements and interpretation of the impact pressure on a pitot tube in low-density flow are discussed. Viscous effects, relaxation effects, orifice-size effects, and internal flow effects are considered. Author

N67-29554# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
THE EXCITATION OF ELECTRONIC AND OTHER DEGREES OF FREEDOM IN A HYPERSONIC SHOCK WAVE IN AIR
Ernest Bauer Jan. 1967 63 p refs
(Contract DA-HC-15-67-C-0011; ARPA Order 5)
(P-311; IDA/HQ67-5724; AD-650950) CFSTI: HC $3.00/MF $0.65

A review is given of the overall mechanisms of energy flow between translational, rotational, vibrational, chemical, and electronic degrees of freedom in a shock wave. Particular stress is placed on those aspects of the problem which are not well understood; namely, the mechanism for vibrational excitation and dissociation in high-speed shocks in which the assumptions of weak translation-vibration coupling and dissociation by vibrational ladder-climbing, which apply at room temperature, break down. While one can write a set of rate constants for at least the major chemical reactions in air, there is no comparable information on the excitation of electronic degrees of freedom in high-temperature air, and our knowledge of mechanisms is very limited. For illustrative purposes, the case of a shock wave in argon is reviewed. Author (TAB)

N67-29606# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
A SURVEY OF CORRELATION LENGTH MEASUREMENTS OF THE VORTEX SHEDDING PROCESS BEHIND A CIRCULAR CYLINDER
Clark Graham 30 Oct. 1966 53 p refs
(Contract Nonr-3963(25))
(TR-76028-1; AD-650849) CFSTI: HC $3.00/MF $0.65

The results of ten investigations were studied to determine what quantities should be measured and where to measure them to obtain realistic correlation lengths. Some experimenters carried out visual observations to estimate the size of the correlated flow. Others measured the fluctuations in velocity, surface pressures, and sectional loading to obtain correlation coefficients which when integrated give correlation lengths. The purpose of the paper was to determine if consistent values for correlation length can be measured using these various techniques. Author (TAB)

N67-29612# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
INVISCID RADIATING FLOW OVER A BLUNT BODY
Ping Cheng and Walter G. Vincenti May 1966 46 p refs
(Contract AF 49(638)-1280)
(SUDAAR-278; AFOSR-66-1399; AD-651668) CFSTI: HC $3.00/MF $0.65

The effect of thermal radiation is investigated for the axisymmetric flow over the blunt body associated with a given paraboloidal shock wave. Radiative transfer is treated by means of the differential approximation, which applies to multidimensional flow and is valid throughout the entire range of temperature and optical thickness. The gas is assumed to be perfect and optically grey, and molecular-transport processes are neglected. A semi-analytical solution for the flow and radiation fields is obtained by the method of series truncation. Results are presented, in the strong-shock approximation, for various values of the appropriate dimensionless variables. In general, radiation is found to have significant influence on temperature and density, moderate effect on velocity, and little effect on pressure. The stand-off distance between the shock wave and the body is found to decrease significantly with increasing radiation; the body shape is less affected. The results show correct physical behavior throughout the flow field for all values of optical thickness. The detailed flow quantities exhibit a number of features of multidimensional radiating flow. They also provide a check on the special assumptions made in other, more approximate treatments. Similarities between radiating flow and nonequilibrium reactive flow over blunt bodies are apparent. Author (TAB)

N67-29614# Poitiers Univ. (France).
THEORETICAL AND EXPERIMENTAL INVESTIGATIONS ON THREE-DIMENSIONAL (LAMINAR AND TURBULENT) BOUNDARY LAYERS, IN PARTICULAR ON PROBLEMS OF TRANSITION, SEPARATION AND REATTACHMENT Final Report
E. A. Eichelbrenner and J.-L. Peube 30 Sep. 1966 101 p refs
(Contract N62558-3863)
(AD-650952) CFSTI: HC $3.00/MF $0.65

The report is chiefly dedicated to the behavior of separation and reattachment in three-dimensional turbulent boundary layers, in particular on ellipsoids and annular wings. TAB

N67-29615# Poitiers Univ. (France).
THE ROLE OF S-SHAPED CROSSFLOW PROFILES IN THREE-DIMENSIONAL BOUNDARY LAYER THEORY Final Report
E. A. Eichelbrenner and J.-L. Peube 30 Sep. 1966 83 p refs
(Contract N62558-4460)
(AD-650953) CFSTI: HC $3.00/MF $0.65

A method is developed which allows the calculation of characteristic parameters (scale factor delta, main flow parameter m, crossflow parameter B) of three-dimensional turbulent boundary layers under the assumption of a third-degree polynomial for the temperature polar. Author (TAB)

N67-29621# Stanford Univ., Calif. Dept. of Civil Engineering.
CAMBERED BODIES IN CAVITATING FLOW—A NONLINEAR ANALYSIS AND DESIGN PROCEDURE
Robert L. Street and Bruce E. Larock Dec. 1966 54 p refs
(Contract Nonr-225(56))
(TR-72; AD-649734) CFSTI: HC $3.00/MF $0.65

A nonlinear method is given for the description, in terms of nonphysical parameters, of fully cavitating cambered bodies in two-dimensional flow. The method, based on complex function theory and the spiral-vortex cavity model, permits a quasi-optimum design of certain classes of hydrofoils. Details of the procedure and means for its extension to other cambered bodies are described. Author (TAB)

N67-29628# New York Univ., N. Y.
GENERALIZED LAW OF THE WALL AND EDDY VISCOSITY MODEL FOR WALL BOUNDARY LAYERS
Gdalia Kleinstein Wright-Patterson AFB, Ohio. Aerospace Res. Labs., Nov. 1966 32 p refs
(Contract AF 33(615)-2215)
(NYU-AA-66-65; ARL-66-0238; AD-649606) CFSTI: HC $3.00/MF $0.65

Based on the logarithmic velocity distribution at distances not so far from the wall and a turbulent shear variation proportional to the cubic power of the wall distance in the immediate proximity of the wall, an analytical model for an eddy viscosity throughout the wall region is derived leading to a closed form expression for the velocity distribution. An extension of the above analysis to include shear variation results in a generalized law of the wall from which the effect of Reynolds number on the velocity distribution is derived. While many applications of the generalized solution are envisaged, as an example, the velocity distribution for the case of injection or suction is considered. The theoretical result is shown to be in agreement with available experimental data. Author (TAB)

N67-29631# ARO, Inc., Arnold Air Force Station, Tenn.
CALCULATION OF NEAR-FREE-MOLECULAR FLUX DISTRIBUTION TO SIMPLE BODIES IN HYPERVELOCITY FLOW
John T. Miller Arnold Eng. Develop. Center, Mar. 1967 32 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-28; AD-649764) CFSTI: HC $3.00/MF $0.65

The calculations presented are based on a first-collision model which allows collisions between the free-stream molecules and the molecules which are re-emitted from the surface of the body. The net effect of these collisions is to partially shield the body from the free stream, reducing both the drag and heat-transfer coefficients from the corresponding values experienced in free-molecule flow. Free-stream Mach number is taken to be essentially infinite and the molecules are assumed to be re-emitted from the body surface at the most probable velocity, instead of possessing a velocity distribution. These assumptions enable the distribution of flux to a given body to be expressed as a function of the degree of rarefaction, as represented by the appropriate Knudsen number. This Knudsen number is composed of a characteristic body dimension and the mean free path of the re-emitted molecules relative to free-stream molecules. The integral equation expressing the incident flux distribution on a general body is developed, and solutions are presented for the disk normal to the free stream and for sharp cones of various apex angles, at zero angle of attack. These flux distributions are then integrated to give drag coefficients ratioed to the corresponding free-molecule values. Author (TAB)

N67-29780*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FORMATION AND PROPERTIES OF LIQUID SHEETS SUITABLE FOR USE IN ROCKET ENGINE INJECTORS
Robert W. Riebling 15 Jun. 1967 36 p refs
(Contract NAS7-100)
(NASA-CR-85105; JPL-TR-32-1112) CFSTI: HC $3.00/MF $0.65
CSCL 20D

When a jet of liquid from a circular orifice is directed tangentially against a concave cylindrical surface, it spreads to form a thin, flat sheet of liquid. Such sheets can be used in several different kinds of liquid propellant rocket engine injectors. An applied research program was conducted to determine the properties of sheets formed in this manner, as well as the conditions necessary to the formation of suitable sheets. Sheet dimensions and spatial orientation, and the distributions of mass and velocity across the flowing sheets were measured, using three inert propellant simulants. All of these sheet parameters were correlated in terms of the geometry of the sheet formation devices. Injection velocity, propellant physical properties, and the absolute size of these devices were found to exert only second-order effects. Distributions of

thickness and momentum flux were also obtained and correlated. All sheet properties were found to be scalable because of geometric and dynamic similarity, and can now be predicted and controlled with a high degree of confidence. Author

N67-29849# New York Univ., N. Y. Dept. of Aeronautics and Astronautics.
THE STABILITY OF FLOW IN TUBES WITH ELASTIC DISSIPATIVE WALLS
Jack Werner Jul. 1966 43 p refs
(Grant AF-AFOSR-178-66)
(NYU-AA-66-62; AFOSR-66-0504; AD-647916) CFSTI: HC $3.00/MF $0.65

Solutions are obtained for internal flows with elastic dissipative walls into which axially symmetric periodic disturbances are introduced. Asymptotic representations for the complete solutions are obtained for large Reynolds no. small wave propagation speeds and disturbance wave-lengths of the order of the tube diameter. The wall impedance required to maintain a neutral stability condition is found and a range of wave numbers for which the impedance has a positive imaginary part corresponding to a viscous damping characteristic is determined. Author (TAB)

N67-29878# Atomics International, Canoga Park, Calif.
A STUDY OF THE EXPANSION OF MERCURY VAPOR
B. J. Ostermier, R. D. Keen, and V. H. Heiskala 15 Mar. 1967 94 p
(Contract AT(04-3)-701)
(NAA-SR-12049) CFSTI: HC $3.00/MF $0.65

A computer program for determining the onset of condensation in a nozzle expansion is described. Experimental evidence for the achievement of high mercury supersaturations is cited, and the components and operation of the experimental mercury nozzle flow system are described. Results of the computer study are discussed and indicate that with dry mercury vapor, no condensation would occur in the experimental nozzle. The experimental data—wall temperatures and static pressures—are presented in plotted and tabulated form for expansions from nozzle inlet pressures between 12.2 and 56.8 psia. Pressure data indicate condensation occurred for expansions for pressures above 30 psia. For all runs, the maximum supersaturations achieved without condensation were calculated using isentropic flow relations and are presented in tabulated form. Wall temperature data did not behave as predicted. An explanation is suggested involving evaporation of entrained droplets in the boundary layer but is not entirely consistent with the data. The effects of an undetected free-stream temperature change on the achieved supersaturations were estimated and are presented in tabulated form. Possible reasons for the occurrences of condensation when not predicted by the theory are suggested as entrained drops in the flow or the failure of the theory to account for the effect of small nuclear size on the surface tension. Suggestions for additional effort are made. Author (NSA)

N67-29915 Aeronautical Research Council (Gt. Brit.)
A STUDY ON THE RUNNING TIMES IN REFLECTED SHOCK TUNNELS
J. A. D. Ackroyd London, HMSO, 1967 39 p refs Supersedes ARC-28631
(ARC-CP-883; ARC-28631) HMSO: 8s

The running time obtainable in a reflected shock tunnel is considered, particular attention being paid to the nature of the unsteady wave starting process in the nozzle. A range of initial conditions has been examined experimentally in a two-dimensional nozzle with a maximum efflux-to-throat area ratio of 100. An approximate analysis based on Chisnell's theory is shown to give reasonable agreement with the experimental results. Author

N67-29918# Aeronautical Research Council (Gt. Brit.)
THE INTERACTION OF THE REFLECTED SHOCK WITH THE BOUNDARY LAYER IN A SHOCK TUBE AND ITS INFLUENCE ON THE DURATION OF HOT FLOW IN THE REFLECTED-SHOCK TUNNEL. PART I
L. Davies London, HMSO, 1966 82 p refs
(ARC-CP-880; NPL-AERO-1158; ARC-27110; AD-805503) HMSO: 17s 6d

An extension is made of the simple model proposed by mark for the interaction of the reflected shock with the boundary layer in a shock tube. It leads to the prediction of a flow of gas along the walls of the tube, originating at the bifurcated foot and directed towards the end wall. When this analysis is applied to the transmitted shock, the prediction is that cold driver gas will quickly arrive at the end of the tube, cooling the gas in the reservoir of the shock tunnel. This occurs for m greater than 3.5 for helium driving nitrogen. It is a faster movement of cold gas towards the end plate than that caused by the general movement of the contact surface. Experimental evidence in support of the theoretical model is given in the form of Schlieren photographs, pressure measurements and heat transfer measurements. The bifurcated foot mechanism is compared with the instability of the contact surface mechanism for cooling the reservoir gas. Both mechanisms predict cooling to occur for m greater than 3.5. An experiment is suggested whereby the two mechanisms may be separated. Test section hot flow duration measurements in conjunction with the theoretical model suggests that where helium is driver and nitrogen is test gas for m less than 3.5 the hot flow and high pressure durations will be similar. Author (TAB)

N67-30028*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TWO DIFFERENT INTERPRETATIONS OF MEASURED DISSOCIATION-RATE CONSTANTS AND THEIR EFFECTS ON COUPLED VIBRATIONAL-DISSOCIATIONAL FLOWS OF OXYGEN OVER A WEDGE
Fred R. De Jarnette Washington, NASA, Jul. 1967 28 p refs
(NASA-TN-D-4028) CFSTI: HC $3.00/MF $0.65 CSCL 01A

To illustrate the effects of vibrational relaxation on the measurements of dissociation-rate constants, this report presents computed flow-field properties for the nonequilibrium flow of oxygen over a wedge using both the coupled vibration-dissociation and the coupled vibration-dissociation-vibration models for two limiting conditions. One condition or interpretation assumes vibrational equilibrium in the rate constant measurements, whereas the other assumes that the rate constant measurements already include the vibrational nonequilibrium effects. The results showed significant differences between the flow-field properties for these two limiting conditions at a Mach number of 27.17 (where dissociation is appreciable) but small differences at a Mach number of 9.45 (where dissociation is small). Author

N67-30060 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ENGINEERING FORMULAS FOR COMPUTATION OF THE FRICTION ON A PERMEABLE SURFACE IN A TURBULENT GAS FLOW
V. D. Sovershennyi [1967] 4 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 12, no. 4, 1967 p 538–539

Simple formulas are proposed for the computation of the friction coefficient on a permeable surface in a turbulent gas flow. These formulas were obtained on the basis of an approximation of computed curves calculated by means of theoretical formulas. A formula is given for the particular case of subsonic isothermal flow and the case when the blown-in material and the material of the basis flow are the same. S.P.

N67-30081*# Massachusetts Inst. of Tech., Cambridge. Center for Space Research.

AN ELECTROHYDRODYNAMICALLY INDUCED SPATIALLY PERIOD CELLULAR STOKES-FLOW

C. V. Smith, Jr., and J. R. Melcher May 1967 29 p refs (Grant NsG-388)

(NASA-CR-85245; CSR-TR-64-4) CFSTI: HC $3.00/MF $0.65 CSCL 20D

An experiment is described in which a spatially periodic, time-invariant electric field is used to create a spatially periodic cellular flow by the action of an electric shear stress in the region of a fluid–fluid interface. The cellular motion is closely related to large amplitude interfacial deformations observed when an electric field stresses the interface between two fluids having nearly the same electrical conductivity. A simple theoretical model is developed for the cell streamlines, flow velocity, and distribution of electric potential, and this model is shown to be in agreement with the experimental observations. Author

N67-30073*# Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering.

A RHEOLOGICAL STUDY OF GLASS FIBERS IN A NEWTONIAN OIL Semiannual Status Report, 1 Dec. 1966–31 May 1967

J. D. Goddard and Leo F. Carter Jun. 1967 44 p refs (Grant NsG-659)

(NASA-CR-85257; Rept.-06673-7-P) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Results are presented of some rheological tests on suspensions of 3.5 micron-diameter glass micro fibers in a 180 poise Newtonian oil. Shear-stress and total-normal-thrust measurements were made, over a range of steady shear rates from 0.01 to 350 sec^{-1}, with a cone-and-plate rheometer. With the exception of the longest fibers, only slight shear thinning was observed. From the total normal thrust studies it is found that the first normal stress difference is approximately linear in the shear rate and is on the order of one-fourth or more the magnitude of the shear stress. Unsteady shear tests failed to reveal any evidence of elastic behavior in the suspensions. Anomalous behavior, with separation during testing was observed with the highest concentrations of the longer particles. Certain parameters, obtained from the theory of dilute suspensions, are proposed tentatively for correlating rheological properties with fiber length and concentration. Author

N67-30095 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.

SUPERPOSITION OF HELICOIDAL FLOW INDUCED BY PROPELLER-SHAPED SWIRL GENERATORS ON FORCED AXIAL WATER FLOW IN BURNOUT EXPERIMENTS

A. Campanile, G. Galimi, and M. Goffi 1966 27 p refs Presented at the Round Table of the European Two Phase Flow Group, Ispra, Italy, 14–17 Jun. 1966

(SORIN-95; M/258)

Burnout points were obtained on an electrically heated tube internally fitted with a vortex generator shaped as a propeller having the same diameter of the tube with blade inclination of 45°. One, two and three swirl generators at a time were used, placed in different axial positions. The experiments were run at pressures ranging between, 80 and 140 kg/cm^2. The results showed a substantial increase of the critical fluxes compared to the corresponding values obtained with the same heater in linear flow experiments. Values of burnout heat flux as high as 3 times the flux corresponding to linear flow run were attained for the same inlet fluid conditions. Author

N67-30116# Swedish State Shipbuilding Experimental Tank, Gotaborg.

CAVITATION INCEPTION ON HEAD FORMS ITTC COMPARATIVE EXPERIMENTS

Hans Lindgren and C. A. Johnsson 1966 35 p refs Presented at the 11th Intern. Towing Tank Conf., Tokyo, 1966 (Rept.-58) CFSTI: HC $3.00/MF $0.65

The results of some comparative cavitation experiments carried out in 17 different cavitation tunnel configurations are presented. The tests included observations of cavitation inception on a head of a body of revolution and observation of when free bubbles were first visible in the test section in front of the body. The influence of test technique and body condition on the test results is discussed. The test results are corrected for boundary influence and compared with calculated and measured values of the pressure minimum. Some of the differences in inception cavitation number obtained in the different tunnels seem to be dependent on observation technique, while some can be attributed to differences in height of the tunnels (maximum static pressure) and diameter of the bodies (boundary layer thickness). An attempt has been made to establish a relationship between some of the parameters representing this influence. Author

N67-30120# Office National d'Etudes et de Recherches Aeronautiques, Paris (France).

TWO-DIMENSIONAL INCOMPRESSIBLE FLOW AROUND SEVERAL PROFILES [ECOULEMENT PLAN D'UN FLUIDE INCOMPRESSIBLE AUTOUR DE PLUSIEURS OBSTACLES]

Robert Legendre 1967 67 p In FRENCH; ENGLISH summary (Rept.-116) CFSTI: HC $3.00/MF $0.65

A geometrical study of the flow potential around several profiles leads to the definition of the three kinds of normal potentials, all the others being linear combinations of them. The problem of uniformity is treated without calculation in an intuitive topological manner. The theta-Abelian function is introduced in the same manner. Then the determination of the potentials is carried out by means of the Poincaré theta-Kleinean functions. Finally, the calculation of the theta-Abelian functions is approached and the Abelian potentials are related to Abelian integrals. Author

N67-30133*# California Univ., La Jolla.

HEAT AND MASS TRANSFER AT A GENERAL THREE-DIMENSIONAL STAGNATION POINT

Paul A. Libby Washington, NASA, Jul. 1967 44 p refs (Grant NGR-05-009-025)

(NASA-CR-817) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The characteristics of the boundary layer at a stagnation point with arbitrary velocity gradients in two orthogonal directions are determined. The principal parameters which characterize these layers are the ratio of velocity gradients, $c \equiv (dv_e/dy)_0/(du_e/dx)_0$, the wall-to-stagnation temperature ratio, g_w, and the mass transfer rate related to f_w. Solutions are obtained for a range of these parameters of interest, in particular for $-1 \leq c \leq 1$; the problem of the two-point boundary conditions is overcome by quasilinearization and exploitation of the asymptotic solutions applicable as $\eta \to \infty$. The results of applied interest relate to the heat transfer; the effect of mass transfer on the heat transfer for arbitrary c is referred to the heat transfer with $c = 1$, i.e., to the axisymmetric case. The heat transfer is shown to have a minimum for $c \cong -0.5$. Of fundamental interest are the complex, cross-flow velocity profiles, i.e., ϕ' profiles, which exhibit both reverse flow and velocity overshoot, and the existence of boundary layers with inner layer solutions of constant shear and zero-heat transfer for the saddle point stagnation point case of $c = -1$. Author

N67-30134# Advisory Group for Aerospace Research and Development, Paris (France).

DISCUSSIONS FOLLOWING THE PRESENTATIONS OF PAPERS AT THE AGARD FLUID DYNAMICS SPECIALISTS' MEETING ON "SEPARATED FLOWS"

Jean Ginoux and Helmut Uebelhack, ed. 1966 48 p refs Meeting held in Rhode-Saint-Genese, Belgium, 10–13 May 1966 (AGARD-CP-4, Suppl.) CFSTI: HC $3.00/MF $0.65

Presented is the discussion which followed the presentations of papers at a meeting on separated flows. The purpose of the meeting was to review and discuss general and practical problems in separated flows from low to hypersonic speeds, to present a good cross-section of the current state-of-the-art, and to provide guidance for future research and development. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-28984# Avco Corp., Wilmington, Mass. Missiles, Space and Electronics Group.

THEORETICAL STUDY OF THE PROPAGATION OF INFRASONIC WAVES IN THE ATMOSPHERE Final Report, Jan. 1964–Feb. 1967

Allan D. Pierce and Charles A. Moo Feb. 1967 66 p refs

(Contract AF 19(628)-3891)

(AVSSD-0059-67-RR; AFCRL-67-0172; AD-650752) CFSTI: HC $3.00/MF $0.65

The theory of the propagation of long-period infrasonic waves from nuclear explosions in the atmosphere is reviewed and the extensions of the theory developed under Contract AF19(628)-3891 are described. A simple demonstration of the theoretical basis of amplitude-yield proportionality is given and work on the extension of the normal mode method to include non-stratified windy atmospheres is described. The formulation for incorporating wind effects into theoretical models is reviewed. A justification of the multilayer method is given and numerical results based on this approximation are summarized. The report includes a listing of all reports, journal articles, and symposia papers written under the contract and includes an extensive bibliography on atmospheric waves and nuclear explosions. Recommendations for future research are given. Author (TAB)

N67-28985# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

WIND MEASUREMENTS IN THE SUBPOLAR MESOPAUSE REGION

James Eugene Morris Jan. 1967 31 p refs

(ECOM-5105; AD-650813) CFSTI: HC $3.00/MF $0.65

Mesospheric wind data obtained with a new high altitude Loki system during the summer of 1966 over Fort Greely, Alaska, are presented. Soundings, utilizing very light chaff as a wind sensor, were scheduled near noon and midnight for a 50-hour period. These data are from a sparsely sampled region of the atmosphere. The diurnal variations and the high velocities observed give valuable information regarding noctilucent clouds, atmospheric tidal oscillations, and the mean summer flow near the subpolar mesopause. TAB

N67-29062# Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

REMOTE MEASUREMENT OF SURFACE TEMPERATURE AND ITS APPLICATION TO ENERGY BALANCE AND EVAPORATION STUDIES OF BARE SOIL SURFACES

Jack Conaway and C. H. M. van Bavel Dec. 1966 147 p refs Sponsored by Army

(Rept.-392; ECOM-2-67P-1; AD-650286) CFSTI: HC $3.00/MF $0.65

The report deals with the measurement of surface temperature under field conditions using an infrared radiometer with a bandpass of 600 to 1300/cm (16 - 7.5 microns). The usefulness of such a method in measuring latent and sensible heat flux over a wet, bare soil surface is explored. A review is given of similar work reported by others and of available methods for using surface temperatures in flux calculations. The theory of infrared thermometry is extensively reviewed and the necessity of measuring surface emittance and sky radiance is explained. A description is given of experimental methods for the calibration of the radiation thermometer, the measurement of surface emittance and of sky radiance, the latter employing a standard surface of which the temperature is monitored. Also, an account is given of equipment and methods for routine measurement of surface temperatures in the field. On three days in the spring of 1966, a comparison was made of measured and calculated evaporation. The measurements were obtained with weighable lysimeters and the calculations based upon radiometrically obtained surface temperatures. The agreement was excellent, proving the adequacy of the log-law transfer function relating vapor gradient to vapor flux. This function can be stated simply as the product of windspeed and drag coefficient. A comparison of similarly computed sensible heat flux with residual values for the same quantity obtained from the energy balance proved inconclusive. This result is attributed mainly to the incidence of vertical divergence of sensible heat flux and to the inequality of transfer coefficients for momentum and sensible heat. Author (TAB)

N67-29068# Oregon State Univ., Corvallis.

OROGRAPHIC EFFECTS ON PRECIPITATION PROCESSES Interim Report, 15 Mar.–14 Sep. 1966

Laurence D. Mendenhall and John V. McFadden Mar. 1967 22 p refs

(Contract DA-36-039-AMC-03712(E))

(ECOM-03712-4; IR-4; AD-650572) CFSTI: HC $3.00/MF $0.65

This report describes some results of preliminary analyses of pulse-to-pulse radar backscatter measurements of precipitation above and below the bright band. Other work reported on includes radar studies of orographic effects on precipitation and an unusual radar view of a lee-wave or rotor. A more comprehensive analysis of this other work will appear in the Final Report. TAB

N67-29113# RAND Corp., Santa Monica, Calif.

LF AND VLF REFLECTION LOSS IN THE LOWER IONOSPHERE: A THEOREM ON ABSORPTION AND ITS APPLICATION

H. G. Booker and C. M. Crain Mar. 1967 35 p refs

(Contract F44620-67-C-0045; Proj. RAND)

(RM-5249-PR; AD-650818) CFSTI: HC $3.00/MF $0.65

Two simple practical methods are given for determining the transmission loss of LF and VLF radio waves obliquely reflected from the lower ionosphere in a nuclear burst environment. The constant K, given in RM-4031-PR, is recalculated and found to equal pi, not 2. A theorem, based on full wave theory, is derived that extends results for a nonabsorbing medium to an absorbing medium with minimum complexity. The assumption is made that in the reflecting stratum, the permittivity profile is exponential. At the height where the level of reflection of the upgoing wave is expected to maximize (by the Field-Engel standard), the authors fit an exponential profile and apply to it their analytical expression for attenuation on reflection. Results are corrected as necessary by application of the nondeviating region technique to take account of attenuation below the reflection level. A remarkably accurate alternative method, the phase-integral procedure, combines the two steps. Both methods can be applied with sufficient accuracy for transmission frequencies as low as 10 kHz without use of computers or elaborate codes. Author (TAB)

N67-29140# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va. Research Inst. for Geodetic Sciences.

DETERMINATIONS OF DIRECT AND INVERSE AZIMUTHS, ZENITH DISTANCE, HOUR ANGLE, DECLINATION AND DISTANCE BETWEEN TWO POINTS ON NORMAL SECTIONS

Angel A. Baldini Feb. 1967 22 p

(GIMRADA-RN-19; AD-649157) CFSTI: HC $3.00/MF $0.65

This research note describes the mathematical formulations developed to provide accurate determinations of the direct and inverse azimuths, zenith distance, declination, hour angle, and chord distance between two points on normal sections. The solution is valid for any distance and for any height of the stations above the ellipsoid of reference. The straight line between two points as they are on the physical surface of the earth is considered as a base line, the orientation of which in a reference system similar to that used to define the stars positions, plays an important role in geodesy in the use of artificial earth satellites, the moon, and minor planets, as is to be shown in future reports. TAB

N67-29225# Kiruna Geophysical Observatory (Sweden).

THE TROUGH SEEN IN HIGH LATITUDE OBSERVATIONS OF THE IONOSPHERIC ELECTRON CONTENT

Ludwik Liszka 9 Jan. 1967 37 p refs

(Contract AF 61(052)-678)

(SR-12; AFCRL-67-0175; AD-650623) CFSTI: HC $3.00/MF $0.65

Results of 15 months observations of the ionospheric electron content made at Kiruna, Sweden are presented. Observations were made using the 40 and 41 MHz beacon of the S-66 satellite. Most of the night-time observations, except for the summer period, show a distinct trough in the electron content. Seasonal and diurnal variations of the trough and of the electron content are studied. Also the corresponding equivalent slab thickness obtained using foF2 data from 6 Scandinavian ionosondes and geomagnetic control of the trough are investigated. Some features of the diurnal variation of electron content during the summer agree with the hypothesis of ionospheric heating by photoelectrons from the sunlit magnetic conjugate ionosphere. Author (TAB)

N67-29226# Naval Research Lab., Washington, D. C.

ANTENNAS FOR THE GEMINI VHF–UHF POLARIZATION EXPERIMENT (D-14) Final Report

Richard L. Eilbert 2 Mar. 1967 42 p refs

(NRL-6501; AD-649912) CFSTI: HC $3.00/MF $0.65

An experiment was conducted to measure the spatial and temporal distribution of free electrons in the lower layers of the ionosphere. This study used a Gemini spacecraft as a platform from which signals at 133.9 Mc and 401.7 Mc were transmitted. A single antenna (a boom-mounted colinear-fed dipole) was used to transmit linearly polarized signals at both of the desired frequencies. The effort in designing this antenna was centered chiefly on attempts to achieve polarization purity in the transmitted signal. The proximity of the Gemini spacecraft acting as a reflector introduced an undesirable component of cross-polarization to the signal. By careful design and orientation of the antenna-spacecraft configuration, this cross-polarized component was minimized. The spacecraft-launched signals were received on 28-foot parabolic antennas at two separate ground stations. The reflectors and pedestals were commercially manufactured. Dual-frequency crossed-dipole feeds were designed and built for these reflectors. Author (TAB)

N67-29298 Advisory Group for Aerospace Research and Development, Paris (France).

GEOPHYSICAL ASPECTS OF RADIO STAR AND SATELLITE IONOSPHERE SCINTILLATIONS

J. Aarons *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 247–266 refs (See N67-29281 16-07)

Evaluated were the causes of amplitude fluctuations in radio signal frequencies transmitted through ionospheric irregularities. A survey of magnetic disturbance and sunspot activity data established their influence on the general level of scintillation and a good correlation between spread-F and amplitude fluctuations was obtained. G.G.

N67-29299 Advisory Group for Aerospace Research and Development, Paris (France).

RADIO-STAR SCINTILLATIONS AND SPREAD F IN THE AURORAL ZONE

L. Owren, E. J. Fremouw, and R. D. Hunsucker *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 313–332 refs (See N67-29281 16-07)

(Contract NAS5-1413; Grant NSF GP-947)

The recent literature on radio star scintillations and spread F in temperate and high latitudes is reviewed. The scintillations of the radio source Cassiopeia A observed with a phase-switch interferometer on 223 Mc/s in the auroral zone at College, Alaska, during the 1958 sunspot maximum and the low activity year 1962 are discussed and compared. A three-fold decrease is found in the scintillation index from 1958 to 1962. The diurnal variation declined in amplitude but not in form. The seasonal variation shows a change in form with the sunspot cycle, from a winter peak in 1958 to equinoctial peaks in 1962. A close relationship between line-of-sight auroral luminosity and radio star scintillations is established and discussed. The characteristics of spread-F occurrences observed are discussed with respect to diurnal, seasonal and sunspot cycle variation. The relationship to magnetic activity, sporadic E and visual aurora is also considered. The combined radio star scintillation and spread-F data for College are studied. This result is interpreted in terms of the two components recognized in the seasonal variation of the radio star scintillation index. Author

N67-29305 Advisory Group for Aerospace Research and Development, Paris (France).

LARGE-SCALE STRUCTURE OF THE AURORAL ZONE F LAYER

L. Liszka *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 409–431 refs (See N67-29281 16-07)

(Contracts AF 61(052)-601; AF 61(052)-678)

The large-scale structure of the F layer has been studied at Kiruna Geophysical Observatory (ρ = 67°.8N, λ = 20.3°E) by observing the Faraday rotation of satellite signals. Large irregularities in the total electron content, about one order of magnitude larger than at moderate geographical latitudes, were observed. A differential method using Faraday rotation records made at two stations spaced about 100 km were also applied in the present study. Author

N67-29306 Advisory Group for Aerospace Research and Development, Paris (France).

IONOSPHERIC INHOMOGENEITIES OVER WALLOPS ISLAND

I. Chidsey *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 423–435 refs (See N67-29281 16-07)

Employing dispersive Doppler from two frequency beacons, on several high altitude research rockets launched at Wallops Island in the period 1959 to 1960 on magnetically quiet days, electron density profiles were obtained. One of these gave clear evidence of inhomogeneities. Author

N67-29312 Advisory Group for Aerospace Research and Development, Paris (France).
DETECTION OF APPARENT IONOSPHERIC MOVEMENTS BY BACKSCATTER TECHNIQUES
B. Dueno *In its* Spread F and Its Effects upon Radiowave Propagation and Commun. 1966 p 527–538 refs (See N67-29281 16-07)
(Contract AF 19(604)-8342)

Unusual echoes from the south direction obtained by means of a frequency swept sounder and a rhombic antenna are discussed. In some cases these unusual echoes are observed to decrease their apparent range, and in some cases to increase their apparent range systematically with time. A qualitative explanation of these unusual echoes in terms of the flat earth and ionosphere approximation is given assuming that all these echoes are due to a time-delay focusing mechanism. Author

N67-29313 Advisory Group for Aerospace Research and Development, Paris (France).
A RESEARCH ON THE F2 IRREGULARITIES BY MEANS OF THE BACKSCATTER TECHNIQUE
I. Ranzi *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 539–542 refs Sponsored by AFCRL (See N67-29281 16-07)

A possibility of an influence exerted by the earth's magnetic field on the focusing properties of the F_2 irregularities is shown. Furthermore, there was an evidence as to a connection between some E_s formations and preceding F_2 irregularities. Since August 1957, the backscatter sounding, on fixed frequencies with fixed or rotating Yagi antennas, has been performed at the experimental station of Torrechiaruccia (42.03°N; 11.83°E; at about 55 km north–west from Rome). The most important results as to the study of the F_2 irregularities are summarized. Author

N67-29314 Advisory Group for Aerospace Research and Development, Paris (France).
A POSSIBILITY TO OBSERVE IRREGULARITIES NEAR THE MAXIMUM OF THE F2-LAYER AND THEIR TRAVELLING VELOCITIES
R. W. Eyfrig *In its* Spread F and Its Effects Upon Radiowave Propagation and Commun. 1966 p 543–548 refs (See N67-29281 16-07)

From recordings of the characteristics of the MUF (3000) F_2 by means of a panoramic ionosonde, time shifts are observed between the ordinary and extraordinary component in cases of typical events. They are interpreted by theoretical considerations. Moreover, it is indicated how the direction and velocity of the front of disturbances may be determined. Author

N67-29323# Isotopes, Inc., Westwood, N. J.
PROJECT STRAP Final Report
R. D. Sherwood 30 Jan. 1967 75 p refs
(Contract AT(30-1)-3615)
(NYO-3615-1) CFSTI: HC $3.00/MF $0.65

Impaction probe samples collected in the lower stratosphere and upper troposphere during November 1965 and March to April 1966 on WR8-57 aircraft weather reconnaissance flights were examined. Electron microscopic measurements of particle diameter (d) suggested a trimodal size distribution: a high population at $0.2<d<4.0$ micron, corresponding to previously reported ammonium sulfate particles; a higher population at $0.02<d<0.2$ micron, corresponding to reported data on Aitken nuclei and insoluble particles found within larger ammonium sulfate particles; and a high population at $0.008<d<0.02$ micron, suspected to be related to structures in the evaporated carbon thin film used for sample collection. Particle number concentrations of 0.05 to 1.5 cm^{-3} for $d>0.2$ micron were higher than values from 1962 to 1963 probe samples, and concentrations of 1 to 15 cm^{-3} for $0.02<d<0.2$ micron were similar to reported values for Aitken nuclei measured in 1961. Presence of ammonium sulfate and persulfate was found by electron diffraction, and of silicon and sulfur by electron microprobe analysis, in agreement with previous work. Beta-count rates indicated that most of the activity was in particles smaller than 1.5 micron diameter. The beta activity for the impaction probes was under 15 percent of the values reported for filter paper samples exposed simultaneously on the same flight. Results of a simple wash procedure show from 2 to 75 percent activity loss via solubility and possible wash off. Particle morphologies resembled those of laboratory generated aerosols of several substances and it is suggested that possible chemical and phase changes occurred after collection. Recommendations to improve sampling and analysis are given. Author (NSA)

N67-29338# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
ATMOSPHERIC TRITIUM. MEASUREMENT AND APPLICATION [LE TRITIUM ATMOSPHERIQUE. MESURE ET APPLICATIONS]
Gerard Frejaville Feb. 1967 24 p refs In FRENCH
(CEA-76) CFSTI: HC $3.00/MF $0.65

The possible origins of atmospheric tritium are reviewed and discussed. A description is given of enrichment (electrolysis and thermal diffusion) and counting (gas counters and liquid scintillation counters) processes which can be used for determining atmospheric tritium concentrations. A series of examples illustrates the use of atmospheric tritium for resolving a certain number of hydrological and glaciological problems. Author (NSA)

N67-29402# Maryland Univ., College Park. Dept. of Physics and Astronomy.
DIRECT PROBE MEASUREMENTS IN THE AURORAL IONOSPHERE Final Report, 27 Mar. 1963–1 Aug. 1965
Richard T. Bettinger and Philip T. Huang Sep. 1966 38 p refs
(Contract AF 19(628)-2792)
(AFCRL-66-825; AD-650644) CFSTI: HC $3.00/MF $0.65

Analysis of vehicle potential measurements in a disturbed ionosphere has provided additional information on the rather difficult problem of plasma-vehicle interaction. The flight data from the Aerobee indicates that under certain conditions, there exists a rather strong correlation between vehicle potential and the ambient charge particle density. Minimum vehicle potentials (i.e., corrected for the induced effects from current collecting devices) exceeding 2 volts in the region of auroral activity suggests the presence of a high energy component in the electron energy distribution, >1 eV. Although the vehicle sheath calculations were performed for ideal conditions, they nevertheless indicate that the presence of a high energy tail enhances the density dependence of the vehicle potential. TAB

N67-29419# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COURSE IN SPHEROIDAL GEODESY
G. V. Bagratuni 15 Feb. 1967 305 p refs Transl. into ENGLISH of the book "Kurs Sferoidicheskoy Geodezii" Moscow, Izd. Geod. lit., 1962 p 1–252
(FTD-MT-64-390; TT-67-61575; AD-650520) CFSTI: HC $3.00/MF $0.65

The textbook covers the materials taught on spheroidal geodesy for fourth-year geodesy students at Soviet colleges and also serves as a guide for postgraduate students and practicing geodetic engineers. Ellipsoidal curves are considered and the theory of the geodetic triangle on the surface of an ellipsoid is explained. The calculation of geodetic coordinates is covered and an entire chapter is devoted to the solution of long-distance geodetic problems. There are chapters on problems of representing an ellipsoid on a sphere and planes, geodetic projections of an ellipsoid on a plane, and problems on the surface of the terrestrial ellipsoid. Author (TAB)

N67-29429*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HIGHER ORDER RING CURRENTS AND PARTICLE ENERGY STORAGE IN THE MAGNETOSPHERE
R. A. Hoffman and P. A. Bracken May 1967 40 p refs
(NASA-TM-X-55810; X-611-67-217) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A system of computer programs has been developed to calculate by successive approximations the ring current magnetic field to any order from an arbitrarily defined distribution of particles in any field model. Using a field model containing the boundary and neutral sheet fields in addition to the main field, third order ring current fields have been calculated for various enhancements of a reasonable particle distribution model. A number of properties of high intensity ring currents have been investigated including the following: (1) Diamagnetism alone poorly describes the field deformation in the heart of the ring current region. (2) In spite of the inclusion of particle energy densities reaching twice the ambient field energy density, the total magnetic field is not inordinately distorted. Self-consistent solutions are easily obtained, and a null point in the field appears difficult to reach. (3) The ratio of particle energy density to final field energy density, β, has been considered. Author

N67-29432*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPRESSIONS FOR THE PRECESSION QUANTITIES AND THEIR PARTIAL DERIVATIVES
Jay Lieske 15 Jun. 1967 27 p refs
(Contract NAS7-100)
(NASA-CR-84999; JPL-TR-32-1044) CFSTI: HC $3.00/MF $0.65 CSCL 08E

The purpose of this paper is to investigate the functional dependence of precession quantities such as ζ_0, z, θ upon the fundamental constants. The effect of small changes of the fundamental constants upon the precession quantities is derived, and numerical partial derivatives are given as power series in time from an arbitrary epoch. Author

N67-29433*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DAILY RESPONSE OF THE UPPER F REGION TO CHANGES IN UPPER ATMOSPHERIC TEMPERATURE AND GEOMAGNETIC ACTIVITY
S. Chandra and B. V. Krishnamurthy Apr. 1967 17 p refs Submitted for publication
(NASA-TM-X-55808; X-615-67-168) CSCL 04A

The day to day variations of the daytime F region electron density at four representative magnetic dip zones, namely 0–5, 25–30, 45–50 and 65–70, are investigated in relation to the other geophysical parameters such as the temperature of the neutral atmosphere, the daily sum of the planetary magnetic indices (ΣKp) and the 10.7 cm solar flux. For this purpose, the plasma frequencies at 1000 km (JFOS) and the critical frequencies (JFOF2) obtained from the Alouette I satellite and the neutral temperatures derived from the Explorer IX satellite drag data over a six month period from October 1962 to March 1963 are used. In general, it is found that the day to day variations of JFOS and JFOF2 in the daytime follow the corresponding variations of the neutral temperature and ΣKp. This trend is not evident with 10.7 cm flux. Correlation coefficients obtained between JFOS, JFOF2 vs temperature and vs ΣKp show a marked latitudinal dependence. Some of the implications of the results obtained in the present investigation are discussed. Author

N67-29434# Advisory Group for Aerospace Research and Development, Paris (France).
FLIGHT-MEASURED TURBULENCE IN THE NATO COUNTRIES
Cyril G. Peckham Feb. 1967 56 p refs
(AGARD-555) CFSTI: HC $3.00/MF $0.65

As atmospheric turbulence environment is one of the primary problem areas in military aircraft structure design, all available data on turbulence were surveyed. The major portion of the data was collected with instruments that record airspeed, altitude, and acceleration at the center of gravity plus elapsed time from takeoff; although the instruments used in the various countries differ, the pertinent information is the same. The use of the discrete gust and the continuous turbulence concepts are discussed in relation to establishing the required spectra for both approaches. All data are reported by the individual countries: Canada, Germany, Italy, France, United Kingdom, and the United States. In addition to the turbulence data, flight loads, commercial survey loads, ground loads, sinking speeds, and runway profile data were also surveyed. Author

N67-29443# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENT OF NITRIC OXIDE IN THE EARTH'S ATMOSPHERE Final Report
Robert A. Young 23 Mar. 1967 42 p
(Contract DA-49-146-XZ-112)
(DASA-1887; AD-649829) CFSTI: HC $3.00/MF $0.65

Status is described of a nitric oxide detector that is being developed for use in the lower ionosphere. The sensor, which operates by selective photoionization of nitric oxide, was essentially completed. The associated electronics were designed. The mechanical components were designed and partially completed. Author (TAB)

N67-29446# Texas A&M Research Foundation, College Station.
THE SPACE OCEANOGRAPHY PROJECT Status Report, Feb.–Oct. 1966
Don Walsh 31 Oct. 1966 45 p
(Contract Nonr-2119(04))
(AD-649697) CFSTI: HC $3.00/MF $0.65

During this period the primary research activity has been in the form of aerial studies on the Mississippi outflow pattern into the Gulf of Mexico. Two flight missions have been made over this region using the specially configured NASA aircraft for multisensor measurements. In addition to discussing these, this report indicates other scheduled operations that could not be carried out due to either weather or non-availability of the aircraft. Project staffing, facilities and capabilities as well as projected research plans for the forthcoming year are outlined together with a consideration of arrangements whereby the utilization of remote sensors for oceanographic studies may be made effective. Author (TAB)

N67-29447# Geo-Science, Inc., Alamogordo, N. Mex.
AIRGLOW OBSERVATIONS AND RESEARCH Final Report, 1 Apr. 1965–30 Sep. 1966
Mark W. Jones Dec. 1966 37 p refs
(Contract AF 19(628)-5062)
(AFCRL-67-0028; AD-649807) CFSTI: HC $3.00/MF $0.65

Under Contract AF 19(628)-5062 Geo-Science, Inc., has conducted airglow observations at Sacramento Peak, New Mexico, and research from April 1965, through September 30, 1966. Observations were made of the oxygen lines at 5577 A and 6300 A, and of the sodium doublet at 5890-96 AA with a birefringent filter photometer. The zenith values of the collected data were scaled and tabulated. Studies of the Sac Peak data showed no significant difference in the diurnal variation of zenith 5577 A for the years 1957-59 sunspot maximum and 1962, sunspot minimum. Harmonic analyses of the average monthly data from 21h-04h for the years 1957-62 were done. Diurnal variation studies were made of the zenith green line intensities for Tonantzintla, Mexico, Huancayo, Peru, and San Juan, Argentina for the years 1957-63.

Studies were made of the seasonal diurnal variations for these and other worldwide stations. Some special analyses were made of the 1965 solar eclipse airglow data from Huancayo, and the variations in airglow intensities during sudden magnetic storm commencements. Considerable effort was expended upon upgrading the airglow equipment and its absolute calibration. It was demonstrated that calibrations using the moon as a source yield valid data. TAB

N67-29471# Norwegian Defence Research Establishment, Kjeller.
SURVEY OF IONOSPHERIC IRREGULARITIES OVER EUROPE
O. Bratteng and J. Frihagen Paris, AGARD, 1966 38 p refs
Sponsored by AGARD
(AGARD-554)

The height of the ionospheric irregularities giving rise to satellite scintillation has been found using spaced receiver observations from several places in Europe and on Spitsbergen. The irregularities are found to be in the 200–400 km range over Europe. Only two observations from Spitsbergen were reducible and gave heights above 400 km. Author

N67-29481# Battelle Memorial Inst., Columbus, Ohio. Remote Area Conflict Information Center.
EFFECTIVENESS STUDY OF REFLECTIVE CLOUDS
R. E. Haas 28 Feb. 1967 24 p refs
(Contract SD-171; ARPA Order 324)
(RACIC-TR-57; AD-650509) CFSTI: HC $3.00/MF $0.65

The report describes a study undertaken to provide quantitative data from which first-order estimates of the reflective power of chemically induced clouds could be made and to provide the means of making first-order estimates related to weapons effects in general. A computer program was developed that uses data consisting of the spectral distribution of the incident energy, the composition of the scatterer, and the size distribution of the scatterer to compute volumetric scattering intensity. Incorporated within the program is a plotting option by which the data may be portrayed graphically. This program is described, as is the application of radiant energy to fire spread, history of this study, and the history of the Mie problem. Author (TAB)

N67-29483# Texas A & M Univ., College Station. Dept. of Oceanography.
OCEANOGRAPHY USING REMOTE SENSORS Status Report, Nov. 1966–Feb. 1967
Luis R. A. Capurro and Dale F. Leipper 1 Mar. 1967 22 p
(Contract Nonr-2119(04))
(AD-650288) CFSTI: HC $3.00/MF $0.65

Most of the investigations programmed in this project depend on the information obtained from the flights made with the research aircraft NASA 926 Convair 240 which was the only one instrumented and in operation. Unfortunately, the output of data from the flight missions was very limited due to inclement weather, the principal cause of either cancellation of the mission or its early termination. From the total of four flight missions scheduled: July, October and December 1966 and February 1967, only two can be considered successful: July 1966 and February 1967. To compensate for those missing missions additional flights in April, June and August 1967 (tentative) will be made. Two technical papers have been produced as a result of the investigation being carried out: 'Experimental Use of Airborne Sensors in the Measurement of Mississippi River Outflow into the Gulf of Mexico', master's dissertation by Lt. Cmdr. Don Walsh, and 'Reflections of the Sea Surface Temperature Field in Low Level Cloud Development: An Observational Air–Sea Interaction Study from Space' by James Arnold (in proc.). In addition to the use of the NASA 926 the services of a high performance jet trainer (T-38) to make overall area photographs of both the Mississippi Delta and Timballer Bay were provided which were simultaneous with one of the NASA 926 low level flights and permitted the comparison of oceanographic phenomena in photographs (color and color infrared) taken simultaneously at two different levels. Author (TAB)

N67-29504# IIT Research Inst., Chicago.
ANALYSIS OF LOW LATITUDE D AND E REGION DATA Semiannual Technical Report, 15 May–15 Nov. 1966
Robert D. Sears Jan. 1967 43 p ref
(Contract N00014-66-C0030; ARPA Order 749)
(IITRI-T-6142-5; SATR-2; AD-649821) CFSTI: HC $3.00/MF $0.65

A technique for determining the electron density profile in the E-region from group path, phase path, amplitude and true height analysis data is described. A selected data period, 1600 to 2100 GMT on 15 to 19 October, is summarized in the detailed reduction and analysis of the individual data obtained from the different measurement techniques. One period of detailed electron density profile computation is presented. The period 1700 to 1800 GMT on October 1962 also included a moderately intense solar flare so that the excess ionization caused by the flare in the lower ionosphere may be observed. The true height analyses which are developed are extensions of the true height analyses of the F-region and serve to extend conventional true height analysis to lower altitudes or lower electron densities than possible from the conventional analyses alone. The data were obtained utilizing ionosondes, a three frequency HF propagation measurement of both phase and amplitude and riometer measurements of cosmic noise absorption. To develop the profiles presented herein, the group height records from ionograms and phase height measurements from the HF experiment were used. TAB

N67-29516# Gulf Coast Research Lab., Ocean Springs, Miss. Oceanography Section.
AIRBORNE MEASUREMENTS OF INFRARED SEA TEMPERATURE IN THE NORTHERN GULF OF MEXICO
Kirby L. Drennan Dec. 1966 41 p refs
(Contract Nonr-3198(01))
(TR-2; AD-650314) CFSTI: HC $3.00/MF $0.65

Quasi-synoptic measurements of the radiation temperature of the sea were conducted over the northern Gulf of Mexico on a near monthly basis during the period November 1963 to June 1965. These data indicate the seasonal and spatial variations of surface temperature, Mississippi River discharge patterns, the effect of the passage of a severe hurricane on the sea surface temperature field, and the major surface features of the circulation in the northern Gulf. TAB

N67-29559# Naval Weapons Lab., Dahlgren, Va.
THE DEEP STRUCTURE OF THE EARTH INFERRED FROM A SATELLITE'S ORBIT. PART I: THE DENSITY ANOMALY
Ernst W. Schwiderski Feb. 1967 88 p refs
(NWL-2077; AD-649682) CFSTI: HC $3.00/MF $0.65

A model of a fluid mantle is described which retains the significant features of the earths interior and is adjustable to the outside gravity field. It is shown that the density anomaly is within the order of approximation governed by Laplace's equation regardless of a fluid or solid mantle hypothesis. The density anomaly is numerically evaluated on the basis of the most recently available satellite-sensed gravity data. While it is virtually impossible to interpret the computed world density maps in terms of tectonic features of the earth's crust on the grounds of a solid mantle assumption, the fluid mantle theory permits such an interpretation which is consistent up to many small details. Since every density anomaly computed seems to have played some role in the evolution of the crustal tectonics of today and, vice versa, because every major tectonic feature appears to be explainable by just the computed density anomalies, it is concluded that the gravity data used yielded a resolution of all essential density anomalies of the mantle. Author (TAB)

N67-29561# Joint Publications Research Service, Washington, D. C.
THE CONTINENTAL SHELF AND SOME PROBLEMS OF SCIENTIFIC AND INDUSTRIAL RESEARCH
D. Ye. Gershanovich 12 Apr. 1967 12 p refs Transl. into ENGLISH from Rybn. Khozy. (Moscow), no. 9, Sep. 1966 p 5–7; no. 10, Oct. 1966 p 6–7
(JPRS-40594; TT-67-31238) CFSTI: HC $3.00/MF $0.65

CONTENTS:
1. THE CONTINENTAL SHELF AND SOME PROBLEMS OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PART I D. Ye. Gershanovich p 1–4 (See N67-29562 16-13)
2. THE CONTINENTAL SHELF AND SOME PROBLEMS OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PART II D. Ye. Gershanovich p 5–7 refs (See N67-29563 16-13)

N67-29562# Joint Publications Research Service, Washington, D. C.
THE CONTINENTAL SHELF AND SOME PROBLEMS OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PART I
D. Ye. Gershanovich *In its* Continental Shelf and Some Probl. of Sci. and Ind. Res. 12 Apr. 1967 p 1–4 (See N67-29561 16-13)

The main physical features of the continental shelf and their influences on the fishing industry are briefly described. The continental liquid and solid redistribution at the shelf is mentioned, and the irregularities of the margin in structure, width, and area occupied are indicated. N.E.N.

N67-29563# Joint Publications Research Service, Washington, D. C.
THE CONTINENTAL SHELF AND SOME PROBLEMS OF SCIENTIFIC AND INDUSTRIAL RESEARCH, PART II
D. Ye. Gershanovich *In its* Continental Shelf and Some Probl. of Sci. and Ind. Res. 12 Apr. 1967 p 5–7 refs (See N67-29561 16-13)

The influences of climatic zonality and width of the continental shelf on the fishing industry are briefly reviewed. It is pointed out that the narrow shelves are more important fishing areas because of the rich biogens present. The circulation of the waters on the continental slope and the narrow shelf is described. N.E.N.

N67-29569 Joint Publications Research Service, Washington, D. C.
POLAR REGION STUDIES IN GEOMAGNETISM AND AERONOMY
S. I. Isayev, ed 10 Apr. 1967 30 p refs Transl. into ENGLISH from the book "Vysokoshirotnyye Issledovaniya v Oblasti Geomagnetizma i Aeronomii" Moscow, Izd. Nauka, 1966 p 3; 5–18; 52–57
(JPRS-40573; TT-67-31217) CFSTI: $3.00

CONTENTS:
1. BRIEF SUMMARY OF THE SCIENTIFIC AND SCIENTIFIC–ORGANIZATIONAL ACTIVITY OF THE POLAR GEOPHYSICAL INSTITUTE (PGI) AND PROSPECTS OF FUTURE RESEARCH S. I. Isayev p 2–18 refs (See N67-29570 16-13)
2. SPATIAL DISTRIBUTION OF SPORADIC E_s IN THE POLAR CAP E. V. Sukhorukova p 19–25 refs (See N67-29571 16-13)

N67-29570 Joint Publications Research Service, Washington, D. C.
BRIEF SUMMARY OF THE SCIENTIFIC AND SCIENTIFIC–ORGANIZATIONAL ACTIVITY OF THE POLAR GEOPHYSICAL INSTITUTE (PGI) AND PROSPECTS OF FUTURE RESEARCH
S. I. Isayev *In its* Polar Reg. Studies in Geomagnetism and Aeronomy 10 Apr. 1967 p 2–18 refs (See N67-29569 16-13)

The history of the founding of the Polar Geophysical Institute on the Kola Peninsula is summarized. Some of the areas of interest at the institute include investigation of the ionosphere, auroras, geomagnetism, cosmic rays, and recent movements and seismic regime of the earth's crust on the Kola Peninsula and the northeastern part of the Baltic Shield. Mention is made of the various research topics being pursued in the auroral laboratory, the laboratory of terrestrial magnetism and geoelectricity, the ionospheric and radio wave propagation laboratory, the cosmic ray laboratory, and the seismology laboratory. Plans for future investigations are also briefly outlined. L.E.W.

N67-29571 Joint Publications Research Service, Washington, D. C.
SPATIAL DISTRIBUTION OF SPORADIC E_s IN THE POLAR CAP
E. V. Sukhorukova *In its* Polar Reg. Studies in Geomagnetism and Aeronomy 10 Apr. 1967 p 19–25 refs (See N67-29569 16-13)

Maps are presented showing the frequency of occurrence of E_s in the polar regions, taking into account all cases of the presence of sporadic E with $fE \geq 3$ Mc/sec. Maps of the frequency of occurrence of E_s were constructed for four months (June, December, March, and September). The following points were noted by analysis of the maps: (1) There is a clear negative dependence between the illumination of the ionosphere and the frequency of the formulation of E_s (2) The presence of a semicircular maximum of the frequency of occurrence of sporadic E_s coinciding with the zone of maximum frequency of occurrence of auroras, is noted by all authors studying this phenomena. (3) In the region of the geomagnetic pole there is an additional maximum of the frequency of occurrence of E_s (4) There is a clearly expressed polar maximum, stronger in winter than in summer, changing position and intensity in dependence on the season and on time. (5) The presence of an intermediate maximum of the frequency of appearance of sporadic layers is situated between the main maximum of the auroral zone and the polar maximum along an arc concentric with the auroral arc. L.E.W.

N67-29640# General Atronics Corp., Philadelphia, Pa.
LARGE APERTURE SEISMIC ARRAYS Quarterly Technical Report, Jun.–Sep. 1966
Bedford, Mass., AFSC, Electron. Systems Div., Feb. 1967 83 p refs
(Contract AF 19(628)-5981; ARPA Order 800)
(ESD-TR-67-220; QTR-2; Rept.-1597-2033-8; AD-649681) CFSTI: HC $3.00/MF $0.65

The report describes three topics considered during the second quarter of Contract AF 19(628)-5981. Three topics reported on are: The estimation of the spectra of transient signals with additive noise; the theoretical aspects of clustering seismometers in a large aperture seismic array; the results of tests of a revised automatic pP phase detection technique. A method has been devised to estimate the energy density spectra of transient events in such a way that the variance of the spectral estimates produced by additive noise is minimized. The study of clusters shows: Dependence of array S/N performance on cluster spacing; a way in which to determine the amount of clustering possible without S/N degredation depending on noise conditions at the receiving site. Tests with the revised automatic pP detector have shown 100% correct results with surface focus events (8), 83% correct results for earthquakes (12), with the remaining earthquakes producing anomalies. Author (TAB)

N67-29655# Naval Air Development Center, Johnsville, Pa.
THE VARIATION OF SOUND VELOCITY AND TEMPERATURE IN THE NORTH ATLANTIC, VOLUME I

Steve F. Torok and Ira T. Ballew 1966 649 p
(NAD-AE-6710, Vol. I; AD-650099) CFSTI: HC $3.00/MF $0.65

The document presents sound velocity and temperature data as a function of geographical area (North Atlantic), month, and season for standard depths. The subject matter presented is taken from historical data available on tape at the Naval Air Development Center. Author (TAB)

N67-29774# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.
AN ATLAS OF AEROSOL ATTENUATION AND EXTINCTION PROFILES FOR THE TROPOSPHERE AND STRATOSPHERE
L. Elterman Dec. 1966 136 p refs *Its* Environ. Res. Papers, No. 241
(AFCRL-66-828; AD-649778) CFSTI: HC $3.00/MF $0.65

Light scattering measurements were carried out to determine the aerosol properties of the atmosphere. First the expression for the aerosol attenuation coefficient is derived, based on the field geometry in conjunction with Rayleigh and aerosol scattering considerations. Then the results derived from the measurements are discussed. The paper concludes with an atlas of 105 profiles for altitudes to about 35 km (the data does not exclude the presence of aerosols with low number density between 35 to 70 km). These profiles consist of aerosol attenuation and extinction coefficients as a function of altitude. Since the coefficients are proportional to aerosol number density, the profiles yield information concerning aerosol stratification. A plot for the computed mean of the 105 vertical profiles is included. TAB

N67-29779 Defence Research Board, Ottawa (Ontario).
BIBLIOGRAPHY OF SOIL DYNAMICS AND SOIL STRUCTURE INTERACTION DURING DYNAMIC OR SIMILAR LOADINGS
G. T. Hughes, J. G. Locker, W. D. Stewart, comp. Mar. 1965 110 p refs
(Grant DRB-1601-20)
(DR-170) CFSTI: $3.00

Reported is an annotated bibliography which contains published and unpublished literature on soil dynamics and soil structure interaction during dynamic or similar loadings. Studies cited are grouped into the following three categories: (1) theoretical studies of the various phenomena associated with dynamic loads in soils; (2) field studies in which movements and forces have been recorded in the natural ground or structures; and (3) laboratory studies of the behavior of various soils and other materials under these loads. S.C.W.

N67-29802# California Univ., Livermore. Lawrence Radiation Lab.
NOTE ON THE STABILITY OF THE E-LAYER
N. C. Christofilos 16 Jan. 1967 12 p
(Contract W-7405-ENG-48)
(UCID-15067) CFSTI: HC $3.00/MF $0.65

Calculations are given that indicate that the value of the destabilizing term in the dispersion relation remains constant during E-layer buildup. The calculations were carried out for a pure azimuthal mode where the operator $(1-\bar{v}\bar{v})$ is proportional to the azimuthal velocity spread v_0. The value of this operator operating at other field components is larger and not proportional to v_0. Consequently, in other modes, the destabilizing term is proportional to n_e/v_0^2, thus decreasing with increasing loading factor. NSA

N67-29935 National Physical Lab., New Delhi (India). Radio Propagation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Dec. 1966 8 p
(RRC-A138, Pt. 2; SG-11)

Predicted sunspot numbers for a 12-month period are tabulated on the basis of observed sunspot number observed up to November 1966, and observed numbers for November 1966 are also given. Other data for November 1966, from participating stations and organizations within India, are the 2000 Mc/s daily average solar flux. M.W.R.

N67-29940# National Physical Lab., New Delhi (India). Radio Propagation Unit.
IONOSPHERIC PREDICTIONS FOR JULY 1967
Feb. 1967 4 p
(RRC-B130)

Three graphs depict ionospheric predictions made in India for July 1967. Predicted median foF_2 (ordinary ray critical frequency) and MUF-4000-F_2 values in Mc/s are given for both north and south latitudes. A nomogram is included for transforming F_2-zero-MUF and F_2-4000-MUF values to equivalent maximum usable frequencies (MUF) at intermediate transmission distances. A conversion scale obtains optimum traffic frequency. M.W.R.

N67-29945 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
HUMMERITE, $Na_4MgV_{10}O_{28}\cdot 24H_2O$, A NEW HYDRATED VANADIUM OF SODIUM AND MAGNESIUM OF THE HUEMUL MINE, MENDOZA, ARGENTINA [HUEMULITA, $Na_4MgV_{10}O_{28}\cdot 24H_2O$, UN NUEVO VANADATO HIDRATADO DE SODIO Y MAGNESIO, DE LA MINA HUEMUL MENDOZA, ARGENTINA]
H. Winchell (Yale Univ.) 1967 22 p refs In SPANISH
(Contract AT(30-1)-2261)
(CNEA-189)

The optical and physical properties of hummerite are discussed briefly. The occurrence of hummerite for the first time in Huemel and Agua Botada, Argentina, is noted, as are its natural and recrystallized color, fluorescence, brilliance, hardness, and specific weight. To determine the dimensions of its unit cell, the Weissenberg and Precesion methods were used. Crystallographic data comparisons on hummerite and a synthetic product are included. R.U.

N67-29982 Ionospharen-Institut Breisach (West Germany).
IONOSPHERE DATA, VERTICAL-ECHO-SOUNDING: FREIBURG, URSI-CODE 131, OCTOBER–DECEMBER 1966 [IONOSPHAEREN-DATEN VERTIKAL-ECHO-LOTUNG: FREIBURG URSI-CODE 131, OKT.–DEZ. 1966]
Dec. 1966 124 p In GERMAN and FRENCH
(Rapt.-244-F; Rept.-245-F; Rept.-246-F)

Presented are ionospheric data obtained by vertical echo soundings over Freiburg, Germany. Data tables cover the period of October through December, 1966. G.G.

N67-29985# Kyoto Univ. (Japan). Kyoto Univ. Library.
CATALOGUE OF DATA IN THE WORLD DATA CENTRE C2 FOR GEOMAGNETISM
Feb. 1967 43 p
CFSTI: HC $3.00/MF $0.65

The geomagnetic data was received during the period from February 1966 through January 1967. A table is also presented of the major solar geophysical events for the period from January 1957 through December 1963, and includes data on solar flare, type IV solar radio burst, polar cap absorption, geomagnetic activity, and cosmic ray intensity. N.E.N.

N67-29995*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
GEOMAGNETIC EULER POTENTIALS
David Stern Jun. 1967 16 p refs Presented at the Conjugate Point Symp., Boulder, Colo.
(NASA-TM-X-55819; X-641-67-308) CFSTI: HC $3.00/MF $0.65
CSCL 08N

Recent results of investigations on geomagnetic Euler potentials are reviewed. Applications to the labeling of conjugate points on the earth's surface and to the magnetosphere are described. Equations for drift shells traced by trapped particles are discussed. N.E.N.

N67-30002*# Volt Technical Corp., Washington, D. C.
HIGH LATITUDE FIELD OF POLAR DISTURBANCES [POLE POLYARNKH VOZMUSHCHENIY VYSOKIKH SHIROT]
P. A. Maysuradze 31 May 1967 7 p Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 7, no. 2, 1967 p 369–372
(Contract NAS5-12487)
(NASA-CR-85243; ST-GM-AI-10617) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The high-latitude field of DP-disturbances is studied by construction of charts of successive disturbed field moments. Since DP-disturbances have their source in the high-latitude ionospheric currents, their dynamics were object of study as a function of D_{st}-variations by means of synoptic charts. The patterns obtained are discussed at length. Author

N67-30029*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
A 10 CPS PERIODICITY IN THE PRECIPITATION OF AURORAL ZONE ELECTRONS
David S. Evans May 1967 32 p refs
(NASA-TM-X-55811; X-611-67-216) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The observation was made, using rocket borne radiation detectors, of a purely temporal 10 cps periodicity in the flux of auroral electrons in the energy range 1 keV to 120 keV. The periodicity was biased toward the higher energy electrons in the sense that it was these that underwent the greatest relative fluctuation. A cross correlation analysis revealed that there was no significant displacement in time between peaks at 16 keV and at 120 keV thereby localizing the mechanism causing the modulation to within about 1000 km of the earth. At the same time that this periodicity was observed a determination of the electron energy spectrum showed that a strong monoenergetic electron component (E≈6 keV) was present in the influx. A process in analogy with that process which produces runaway electrons in laboratory plasmas is proposed to account for both the presence of 100 keV electrons in the beam and the appearance of 10 cps periodicity in their flux. The beam of 6 keV electrons as it entered the increased electron density of the upper F layer may have excited a variety of plasma oscillations. Conditions may have been proper for one of these waves to grow in amplitude. A resonance between the frequency of this wave and the gyrofrequency of the 6 keV electrons could then lead to the rapid acceleration of certain favored electrons to very high energy. The time constant of the excitation, growth and subsequent damping of this wave is then reflected in the low frequency periodicity observed in these accelerated electrons. Author

N67-30030*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
POLAR CAP ABSORPTIONS AND ASSOCIATED SOLAR-TERRESTRIAL EVENTS THROUGHOUT THE 19th SOLAR CYCLE
Yukio Hakura Jun. 1967 56 p refs
(NASA-TM-X-55812; X-640-67-258) CSCL 04A

Solar cycle variations in the high-energy-particle-emission of the sun is examined using daily PCA-indices, selected solar-terrestrial events, along with satellite observations of low energy solar protons, in the years 1954–65. A close relation between PCA's and type IV solar radio outbursts existed throughout the last solar cycle. The solar corpuscular activity showed three peaks in 1957, 1960, and 1963, giving an asymmetric Butterfly shape to the latitude-time distribution of type IV-sources. The first peak, which coincides with a sole maximum of sunspot numbers, is characterized by a random occurrence of type IV outbursts, PCA's, and geomagnetic SSC's. Active centers were restricted in two parts of narrow heliographic longitudes during the second, the most prominent peak, giving a slight 27 days-recurrence to the corpuscular activity. Finally, a pronounced peak of 27 days-recurrence appeared during the third period in spite of a rather decreased corpuscular emissivity. A recurrent series of solar MeV protons lasted for 15 solar rotations, while those of the geomagnetic Kp index and galactic cosmic ray intensity lasted for 25 rotations. The appearance of recurrent MeV protons in the later phase of a solar cycle is controlled not only by the sector structure of the interplanetary space, but also more fundamentally by the energetic proton-productivity of the sun. Author

N67-30038 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 158
16 Jun. 1967 134 p refs
(JPRS-41443; TT-61-11147-158)

Recent Soviet publications on research in astronomy, meteorology, oceanography, geophysics, upper atmosphere, and space are presented in summary form. Complete bibliographic information accompanies each article. R.N.A.

N67-30039# Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 157
2 Jun. 1967 106 p refs
(JPRS-41250; TT-61-11147-157)

Reported is a serial publication consisting of materials gathered from recent publications of the Sino-Soviet Bloc countries in the areas of geophysics, astronomy, and space science. Data are presented in the form of abstracts, summaries, and occasional full translations of articles on subjects reflected in the table of contents. Complete bibliographic information accompanies each article. S.C.W.

N67-30057 Defence Research Telecommunncations Establishment, Ottawa (Ontario).
ALOUETTE I IONOSPHERIC DATA ALOSYN, 16–30 APRIL 1964
1 Jan. 1967 165 p
CFSTI: HC $3.00/MF $0.65

Alosyn, Alouette topside sounder synoptic data consisting of selected ionospheric parameters obtained from Alouette I ionograms, is presented in tabular form. The parameters are listed in the order in which the ionograms are recorded and represents sounder data recorded from 15 telemetry stations. The Alouette I satellite is in an almost circular orbit with an inclination of 80.5°; the orbital period is 105.4 minutes; and the topside sounder radio frequency changes continuously from 0.5 to 11.8 Mc/s. The complete sweep takes approximately 11 seconds. The orbital position, the gyrofrequency, and magnetic dip angle are calculated from a computer program. S.P.

N67-30058 Defence Research Telecommunications Establishment, Ottawa (Ontario).
ALOUETTE I IONOSPHERIC DATA ALOSYN, 1–15 APRIL 1964
1 Jan. 1967 134 p For abstract see N67-30057
CFSTI: HC $3.00/MF $0.65

N67-30062*# Princeton Univ., N. J. Dept. of Geology.
CONNECTION AND STRESS PROPAGATION IN THE UPPER MANTLE
Walter M. Elsasser 15 Jun. 1967 66 p refs
(Grant NsG-556)
(NASA-CR-85246; TR-5) CSCL 08J

The upper mantle is taken as relatively shallow, of about 800 km depth. It is assumed that the lower mantle has been drained of its radioactivity and possibly of much of its lighter constituents in an early phase of the earth's history. This was accompanied by general convection in the lower mantle, leaving the latter with a low temperature gradient and no heating, so that it is now convectively inert. The main feature of upper-mantle convection is the preponderance of horizontal motions. This can only in part be attributed to the relative shallowness of the layer; it is mainly caused by a pronounced minimum of the "viscosity" between about 100 and 200 km depth. The existence of such an "asthenosphere" is readily explained by the fact that the closest approach to melting must occur in this region. Mechanical stresses are preferentially transmitted horizontally, along the tectosphere. This accounts for the otherwise unintelligible correlation between ridges, considered as upwellings in the mantle, and continental margins which are shallow features on a mantle-wide scale. It is concluded that the convective circulation in the upper mantle is largely controlled by irregularities of its free upper surface, in a manner inverse in which thermal convection of a fluid is controlled by the corrugations of its lower boundary. Author

N67-30083* Minnesota Univ., Minneapolis. School of Physics and Astronomy.
A NOTE ON THE EFFECT OF RE-ENTRANT ALBEDO ELECTRONS ON THE MEASUREMENTS OF HIGH ENERGY ELECTRONS MADE AT GEOMAGNETIC LATITUDES $\leq 40°$
William R. Webber Apr. 1967 17 p refs
(Grant NGR-24-005-050)
(NASA-CR-85247; CR-94) CSCL 04A

The return of high energy splash albedo electrons and positrons is investigated under the limitations of Stormer theory. Contrary to conditions at high latitudes where the splash albedo is confined closely to the lines of force and re-enters the atmosphere at the conjugate latitude, it is found that at geomagnetic latitudes of $<30°$, the re-entrant particles are not restricted to their latitude of emission but may arrive in a broad band, ranging up to $\pm 40°$ from the equator. The re-entering particles preserve neither the latitude nor the direction of emission. The equatorial regions of the earth are thus subject to a diffuse flux of re-entrant electrons and positrons up to the maximum energy that cannot escape to infinity at the equator, which may be as high as 60 BeV. These particles will return to the earth with energies and directions unrelated to the usual Stormer cut-off criteria for particles arriving from infinity. As a result, the flux of particles arriving above the cut-off energy for particles arriving from infinity in a particular direction at a particular location may contain not only extra-terrestrial particles, but an appreciable fraction of re-entrant albedo as well. Author

N67-30076 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NO. 156
16 May 1967 101 p refs
(JPRS-41057; TT-61-11147-156) CFSTI: HC $3.00

Reviews and abstracts with complete bibliographic information are presented. In meteorology, the subjects include atmospheric optics, cloud physics, boundary layer dynamics, and thermal characteristics of the atmosphere. Oceanographic articles cover underwater measuring equipment, oceanic currents, underwater acoustics, and temperature measurements. Subjects presented under terrestrial physics include seismic and acoustic instruments, techniques, and area studies; geodetic and tectonic mapping; glaciology and sedimentation; wave and gravity field measurements; and rock deformations. Abstracts of works in upper atmosphere and space research cover satellite stability and observations; cosmic radiation studies; lunar mapping and TV camera; a method for studying meteors; and spacecraft launchings. One abstract reviews the alphanumerical output from the Ural-2 computer. K.W.

N67-30110 National Physical Lab., New Delhi (India). Radio Propogation Unit.
SOLAR AND GEOPHYSICAL DATA, PART 2
Feb. 1966 15 p
(RRC-A140, Pt. 2)

Tables and graphs of the January 1967 data are presented for sunspot numbers, solar flux, solar flares, magnetic storms, and ionospheric effects of solar storms. N.E.N.

N67-30115 Potchefstroom Univ. for Christian Higher Education (South Africa). Dept. of Physics.
COSMIC NOISE ABSORPTION AT SANAE DURING 1964 AND THE AURORAL ABSORPTION ZONE
G. J. Kuhn Sep. 1966 28 p refs

Cosmic noise absorption measured by a 30 Mc/s riometer from April to December 1964, at the South African Base, SANAE (83.9°S, 43.8° geomagnetic), was used to determine the temporal and latitudinal variation in ionospheric absorption of cosmic noise. The following temporal variations were found at SANAE: (1) a seasonal variation in the average absorption with a minimum in August, and (2) a daily variation in absorption during the southern winter and spring, but not during the southern summer. Basler's curve for the latitudinal variation in absorption was used to determine the position of the southern auroral zone and auroral absorption zone in relation to SANAE. Individual absorption events of types F and S were analyzed and correlated with aurora and geomagnetic disturbances. Author

N67-30119 Potchefstroom Univ. for Christian Higher Education (South Africa).
AIRGLOW AND ENHANCED PENETRATING ELECTROMAGNETIC RADIATION IN THE SOUTHERN RADIATION ANOMALY
A. J. Van Der Walt, P. H. Stoker, J. P. Maree, P. B. Zeeman, and F. M. Hamm (Stellenbosch Univ.) [1966] 27 p refs Submitted for publication

Enhanced electromagnetic radiation was observed with a 4"×4" NaI(T1) scintillation crystal during an aeroplane flight at 307 g/cm^2 atmospheric depth in a magnetic south direction from Cape Town. These enhancements were recorded where particles trapped on magnetic shells between $L=2.7$ and 3.4 would mirror at negative altitudes due to anomalously low geomagnetic field intensities. The enhancements were observed during a moderate magnetic disturbance, with $K_p=4$, from 2100 to 2400 U.T. on October 5th, 1964. The intensity of the enhanced radiation, as measured in each of four energy ranges from 0.155 to 1.67 MeV, was of the same order of magnitude as the cosmic-ray gamma background. Peaks in the enhanced radiation intensity appear to coincide with bays in the horizontal component of the geomagnetic field. Simultaneous airglow measurements showed higher intensity in the 5577 Å OI-line during this time. Author

N67-30147*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PROCESSING OF THE TOTAL FIELD MAGNETOMETER DATA FROM THE OGO-2 SATELLITE
R. A. Langel Jun. 1967 82 p refs
(NASA-TM-X-55822; X-612-67-272) CFSTI: HC $3.00/MF $0.65
CSCL 08N

The process of reducing the OGO-2 magnetic field data from the original data acquisition and recording (pulse code modulation data only) to the preparation of the final data set used for analysis is described in detail. The OGO-2 telemetry system, magnetometer, and associated instrumentation are also described. An effort is made to point out both the unsuccessful and successful data reduction techniques used as well as what procedures would be used now if the processing were to begin afresh, and how to best utilize the new generation of computer hardware which is becoming available. R.N.A.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-28997# RAND Corp., Santa Monica, Calif.
A STRUCTURE FOR THE BAYES ANALYSIS OF THE PERFORMANCE OF DETECTION SYSTEMS WITH MULTIPLE SENSORS AND SITES
David Middleton Mar. 1967 27 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5211-PR; AD-649668) CFSTI: HC $3.00/MF $0.65

Extends the usual Bayes analysis for optimum detection systems to include the costs of equipment, location, maintenance, and operation. Also included are the customary preassigned costs for correct and incorrect decisions when passive sensors at multiple receiving sites are used to acquire and process data as to the presence or absence of a signal source. A risk formalism is constructed that indicates how the expected overall costs of both decision and operation can be generally determined for a variety of realistic cost models. The physics of the particular detection system—radar, radio, acoustic, seismic, etc.—is included in the usual way under the important constraint of system optimality (Bayes decisions). A simple analytic example is used to illustrate the approach. The method is in no way changed when varied and more complicated types of sensing are included. Author (TAB)

N67-29001*# International Information, Inc., Philadelphia, Pa.
THICKNESS MEASUREMENT OF THIN FILMS DURING THEIR PRODUCTION PROCESS IN VACUUM [IZMERENIYE TOLSHCHINY TONKIKH PLENOK V PROTSESSE IKH POLUCHENIYA V VAKUUME]
O. M. Sorokin and D. I. Dzhioyeva Washington, NASA, Dec. 1966 7 p refs Transl. into ENGLISH from Pribory i Tekhn. Eksperim. (Moscow), v. 2, no. 2, 1966 p 187–190
(Contract NASw-1499)
(NASA-TT-F-10461) CSCL 14B

A device for controlling thin-film thickness during the production process is described, that is based on the fact that the resonant frequency of a quartz oscillator varies during the deposition of a thin film of a material onto the quartz crystal. The device makes use of two quartz oscillators that alternately act as measuring and comparative units. This makes it possible to double the range of the operating frequencies of the device and, thus, the range of the thicknesses measured. An electronic circuit is devised for separating the difference frequency of the quartz oscillations and transforming sinusoidal into pulsed voltage to facilitate operation in combination with a standard counting-rate meter. Some characteristics of the device are given. Its transconductance is ≈3.6 Hz/Å for gold, 1.7 Hz/Å for silver, and 0.9 Hz/Å of aluminum. The sensitivity of film-thickness measurement for these metals is ≈1.2, and 4 Å, respectively. Author

N67-29012*# International Information, Inc., Philadelphia, Pa.
DEVICE FOR MEASURING THE TEMPERATURE OF A GAS FLOW [USTROYSTVO DLYA IZMERENIYA TEMPERATURY GAZOVOGO POTOKA]
N. F. Peshekhonov Washington, NASA, Jun. 1967 3 p refs Transl. into ENGLISH from Russian Patent no. 127841 (Appl. no. 633916/26, Jul. 1959)
(Contract NASw-1499)
(NASA-TT-F-11023) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The device proposed has the ends of the deflectors embedded flush with the shaft. The device has the configuration of a cylindrical shaft which is inserted into the gas flow and whose free end is equipped with a catch which is attachable to the wall of the test piece. Several deflectors are embedded in the shaft flush with it at different distances from each other; their axes are perpendicular to the axis of the shaft. The hot junctions of the thermocouples are distributed inside the deflectors; these junctions have electrodes made of chromel and copel. The deflector at the input has an aperture with conical chamfering and there is an aperture of 0.5 to 1 mm in diameter at the outlet for the outflow of the gas. One junction of the thermocouple is located in each deflector. The electrodes inside of the shaft of the thermocouple are insulated from each other by means of an asbestos string impregnated with a mixture consisting of molten glass, quartz powder, and caolin. This insulation allows the thermocouples to operate without failure in a temperature range of from −30 to +500°C. Author

N67-29019*# Farnum (Frank C.) Co., Philadelphia, Pa.
ASSEMBLY FOR DETERMINING THE TEMPERATURE DEPENDENCE OF THE THERMAL CONDUCTIVITY COEFFICIENT, THERMAL EMF, AND SPECIFIC ELECTRICAL RESISTANCE OF CERMET MATERIALS [USTANOVKA DLYA OPREDELENIYA TEMPERATURNOY ZAVISIMOSTI KOEFFITSIYENTA TEPLORPROVODNOSTI, TERMO-E. D. S. I UDEL'NOGO ELEKTROSOPROTIVLENIYA METALLO-KERAMICHESKIKH MATERIALOV]
S. N. L'vov, P. I. Mal'ko, and V. F. Nemchenko Washington, NASA, Jun. 1967 4 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), v. 6, no. 9, 1966 p 89–91
(Contract NASw-1497)
(NASA-TT-F-11057) CFSTI: HC $3.00/MF $0.65 CSCL 14B

An assembly is described for measuring the thermal conductivity coefficient, thermal EMF, and specific electrical resistance of cermet materials at temperatures from 200° to 1200°C in a vacuum. The assembly accommodates two cylindrical samples simultaneously. Author

N67-29039*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF THREE LIQUID-METAL QUALITY MEASUREMENT TECHNIQUES
Ted W. Nyland Washington, NASA, Jun. 1967 34 p refs
(NASA-TN-D-4038) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Three techniques were theoretically evaluated to determine potential accuracy and design problem areas. The techniques considered were calorimetric, flow measurement, and acoustic techniques. Calorimetric techniques had root-sum-square errors ranging from 0.0028 to 0.015 for heating and condensing calorimeters, to 0.0027 for throttling calorimeters. These estimates were based on applying systematic corrections for heat losses and did not include sampling errors. Sampling errors may approach 0.01 or more. Two-phase flow measurement techniques have potential root-sum-square errors of 0.014 in a small range of weight flows around the design point. Problems associated with achieving thermodynamic equilibrium during the passage of an acoustic pulse in a two-phase fluid apparently limit the application of sonic velocity measurement techniques. Author

N67-29044# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPONENTS AND ELEMENTS OF GYROSCOPIC INSTRUMENTS
N. F. Babayeva and V. M. Yerofeyev 5 Dec. 1966 575 p refs Transl. into ENGLISH of the Book "Detali i Elementy Giroskopicheskikh Priborov" Leningrad, Sudpromiz, 1962 p 1–306
(FTD-HT-66-359; TT-67-61578; AD-650616) CFSTI: HC $3.00/MF $0.65

Problems in the design and planning of standard components and elements for gyromotors, suspensions, gimbals, power transmission devices, erecting and caging devices, gyroscopic servosystems, and pickoffs are considered. The book is intended for engineers in the instrumentation industry and as a study aid for students in Soviet instrument-design institutes. Author (TAB)

N67-29058# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A SIMPLE EPR SPECTROMETER
Kwang-Tze Shu and Shou-ling Huang 25 Jan. 1967 15 p refs Transl. into ENGLISH from Hua-Hsueh Hsueh-Pao (Peking), v. 29, no. 4, 1963 p 373–378
(FTD-TT-65-2010; TT-67-61673; AD-651083) CFSTI: HC $3.00/MF $0.65

A review is given of various types of spectrometers in current use. Construction details of a simple X-band electromagnetic resonance spectrometer is given, and the performance is noted. Tests showed that its sensitivity is such that 3 to the 10 to the minus 8th power mole of DPPH (1,1 diphenyl-2 picryl hydrazyl) can be detected by an oscilloscope with a signal to noise ratio of 15 to 1. TAB

N67-29064# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DUSTLESS FACTORY, A SPECIAL ENVIRONMENTAL REQUIREMENT IN THE MANUFACTURE OF PRECISION GYROSCOPES
Ming Wu 25 Jan. 1967 12 p Transl. into ENGLISH from Hang K'ung Chih Shih (Communist China), v. 2, no. 7, 1965 p 8–10
(FTD-HT-66-412; TT-67-61593; AD-650745) CFSTI: HC $3.00/MF $0.65

The article reviews the manufacture, testing, design, and employment of gyroscopes in high-speed aircraft and the ICBM. Author (TAB)

N67-29066# Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
A FATIGUE APPARATUS FOR USE IN STUDIES OF CRACK PROPAGATION AND DISLOCATION MORPHOLOGY IN FATIGUE
Thomas Benjamin Wade 31 Jan. 1967 95 p refs
(Contract Nonr-1228(32))
(TR-3; AD-650697) CFSTI: HC $3.00/MF $0.65

A direct stress hydraulic fatigue apparatus has been constructed for use in a study of fatigue behavior and crack propagation in metals. The loading apparatus provides a static load, either tensile or compressive, of up to 290 pounds with a superimposed cyclic load (tensile and/or compressive) of up to 3350 pounds. The frequency of loading may be varied continuously from 560 cpm to 1250 cpm. Both the magnitude of load and the frequency of loading may be altered at any time during a test. Tests may be conducted in various gaseous and vapor environments as well as in vacuum of up to 0.000001. Temperature control is not included in the initial design, but may be added easily. Auxilliary equipment has also been constructed for sample preparation and observation of crack propagation. TAB

N67-29071# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ELECTRONIC INSTRUMENT FOR MEASURING VELOCITY, DISTANCE TRAVERSED AND TIME [ELEKTRONNYY PRIBOR DLYA UPREDELENIYA SKOROSTI, PROYDENNOGO RASSTOYANIYA I VREMENI]
D. N. Chekalov, L. G. Mulyar, V. I. Krasikov, A. K. Miroshnichenko, and N. E. Smirnov 23 Jan. 1967 17 p Transl. into ENGLISH from Russian Patent No. 170776 (Appl. No. 822710/26-24, 4 Mar. 1963) p 1–5
(FTD-HT-66-694; AD-650799) CFSTI: HC $3.00/MF $0.65

The report contains a device which measures velocity, distance traversed, and time, combines a high-precision tellurometer, a phase recorder equipped with a unit for converting sinusoidal signals to pulsed signals, and a unit for measuring phase differences. Readings are made visually. The circuit connections of the device, consisting of a series of computer-type modules. English translation. Author (TAB)

N67-29075# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DEVICE FOR AUTOMATICALLY MEASURING THE PARAMETERS OF TUNNEL DIODES [USTROYSTVO DLYA AVTOMATICHESKOGO IZMERENIYA PARAMETROV TUNNEL'NYKH DIODOV]
E. M. Andrianov and I. Ya. Klyavin'sh 23 Jan. 1967 8 p Transl. into ENGLISH from Russian Patent no. 171449 (Appl. no. 834183/26-9, 3 May 1963) p 1–2
(FTD-HT-66-698; AD-650800) CFSTI: HC $3.00/MF $0.65

The patent describes a device which automatically measures the parameters of tunnel diodes. The instrument contains a unit which converts the measured values of maximum and minimum current to a dc voltage. A digital printout attachment for recording the converter parameters and a unit which measures diode voltages which correspond to the values of maximum and minimum current are connected through commutators to the conversion unit. The device also contains a control unit and a power supply. Accuracy during automatic measurement of diode parameters is improved by using an automatic compensator in the voltage measurement unit. The compensator is connected to the control unit. The conversion unit has a variable voltage supply connected to its input and a pulse shaper connected to its output. The pulse shaper generates signals which control switching of the measurement and recording instruments. English translation: 4 pages. Author (TAB)

N67-29085# Perkin-Elmer Corp., Norwalk, Conn. Optical Group.
ULTRASONIC THREE DIMENSIONAL IMAGING USING HOLOGRAPHIC TECHNIQUES Final Report
Justin L. Kreuzer Watertown, Mass., Army Mater. Res. Agency, 31 Mar. 1967 39 p refs
(Contract DA-19-066-AMC-286(X))
(PE-TR-8523; AMRA-CR-66-12(F); AD-650224) CFSTI: HC $3.00/MF $0.65

This report describes an investigation of the basic feasibility of making ultrasonic holograms and of obtaining from them three-dimensional images of optically opaque objects. Experimental equipment was fabricated to make ultrasonic holograms in water of objects up to 5 cm in diameter at an ultrasonic frequency of 5 megahertz. The resulting holograms were then used to make visible images. Holograms of objects examined in water where the ultrasonic wavelength was 0.3 mm show image detail smaller than 1 mm. A hologram was also made of a 3-mm diameter hole in an aluminum block where the ultrasonic wavelength was 1.3 mm. The hole was at 45 deg. to the hologram plane. Conventional coherent and incoherent visible light photographs of the same objects are presented for comparison. The appendix presents a theoretical analysis of ultrasonic holograms and the images produced from them. Author (TAB)

N67-29093# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THEORY, DESIGN AND PERFORMANCE OF A RING CIRCULATOR
S. D. Ewing, Jr. and J. A. Weiss 17 Jan. 1967 22 p refs
(Contract AF 19(628)-5167; ARPA Order 498; Proj. Defender)
(TR-429; ESD-TR-67-21; AD-650282) CFSTI: HC $3.00/MF $0.65

The single transmitter/single receiver Delta Configuration will be the most suitable configuration for use in a manual weld inspection probe. Test results similar to those presented in this report could be obtained on any of the structural weldments (butt weld) observed during a recent survey of shipyard welding practices. The ultrasonic instrumentation, the weld surface preparation, and the accessibility of the weldments, noted during the survey, would be compatible with Delta weld inspection using a manual probe. Feasibility of tee weld inspection with the Delta Technique has been established; however, the test results reported in this phase of testing are preliminary and should not suggest an optimum test for tee configuration weldments. The success of the initial tee weld tests indicated, however, that a set of general parameters for Delta weld inspection has been determined and that application of these parameters to inspection of various weld configuration need only minor change or addition. The knowledge gained from the study of transmitter lens designs, oscillating search unit motions, and multi-search unit Delta Configurations should provide the data input necessary to optimize the Delta Technique for inspecting various weld configurations and thicknesses. TAB

N67-29114# Army Materials Research Agency, Watertown, Mass.
A REPORT GUIDE TO ULTRASONIC TESTING LITERATURE. VOLUME IV: MONOGRAPH SERIES
Ernest H. Rodgers and Charles P. Merhib, comp. Apr. 1967 138 p
(AMRA-MS-67-03; AD-650279) CFSTI: HC $3.00/MF $0.65

The guide is Volume IV of a series of planned report guides consisting of the complete coverage of items in the AMRA Nondestructive Testing Information Analysis Center covering the subject of ultrasonic testing exclusive of those items in the Center utilizing methods of ultrasonic attenuation. TAB

N67-29134# Michigan Univ., Ann Arbor. Infrared Physics Lab.
REMOTE SENSING OF ENVIRONMENT Progress Report, 1 Aug. 1966–31 Dec. 1966
Virginia L. Prentice Apr. 1967 28 p refs
(Contract Nonr-1224(44))
(Rept.-4864-12-P; AD-650581) CFSTI: HC $3.00/MF $0.65

This document reports investigation of progress in the unclassified areas in the technology of remote sensing of environment. It includes a synopsis of progress in the field as reported at the Fourth Symposium on Remote Sensing of Environment, a discussion of the existence and availability of unclassified imagery, and a summary of related activities. A selected bibliography of material published in the open literature is also included. TAB

N67-29155*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY INSTRUMENTS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 193–201 (See N67-29141 16-34)

A gaussmeter with a Hall-effect probe to monitor the field of a permanent magnet in a mass spectrometer is described. The accuracy required in knowing the field strength is indicated as being 1 part in 240. The design considerations, circuitry, and instrumentation are covered. Mathematical discussions are given for the transfer function, thermal analysis, and input offset, reference voltage, and Hall probe tracking errors. N.E.N.

N67-29156*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE INSTRUMENTS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 202–208 refs (See N67-29141 16-34)

The feasibility of extending the method of topographic mapping of the moon using monoscopic photographs and surface photometric properties to surfaces with different photometric properties is discussed. It was concluded that the photometric method appears to be severely limited. Tests on slow-scan vidicons are also reported. It was determined that antimony–sulfide–oxide–sulfide photoconductor has low storage and high residual image characteristics. Selenium-based photoconductors have lower residual signal and better image storage but also have an upper temperature of limitation of 45°C. A modified selenium photoconductor, which can go to 55°C, is recommended for interplanetary photography. N.E.N.

N67-29265# Harvard School of Public Health, Boston, Mass. Harvard Air Cleaning Lab.
A REVIEW OF DETECTION SENSITIVITY FOR MONITORING OF Kr-85
D. G. Smith, P. C. Reist, and L. Silverman 1 Feb. 1967 30 p refs
(Contract AT(30-1)-841)
(NYO-841-5) CFSTI: HC $3.00/MF $0.65

The overall objective of this study was to develop a ^{85}Kr monitoring instrument capable of detecting a field concentration of 3×10^{-9} μCi/cc. A review is given of the major ^{85}Kr detection methods and the readily available sensitivities for each are tabulated. Several specially designed detectors containing an adsorbent for concentrating ^{85}Kr in the immediate vicinity of the detector are suggested and tentatively evaluated. Also discussed are possible mechanisms for concentrating krypton in a sample stream prior to measurement. Of all methods considered, this latter approach appears most promising for increasing the detection sensitivity for ^{85}Kr. Author (NSA)

N67-29391# Texas A&M Univ., College Station.
PROGRESS OF RESEARCH IN ELECTRONICS AND EQUIPMENT DESIGN
L. E. Fite and H. T. Russell *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 5–22 refs (See N67-29389 16-24)

A cooled lithium drifted germanium detector, with an active volume of 4 $cm^2\times.5$ cm, was acquired and tested to determine its performance to the available multichannel analyzers. Methods of coupling these 400 channel analyzers to provide a 1200 channel memory capacity for the Ge(Li) detector are discussed. Experiments performed to achieve a reduction of the matrix interference by instrumental means and the associated circuitry are cited. Described are a 1200 channel analyzer for use with a Ge(Li) detector in activation analysis; instrumental means of reduction of matrix interference on gamma ray spectrometer data; and an electronic device for automatic scanning with a fixed detector. S.C.W.

N67-29408# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NUCLEAR MAGNETIC RESONANCE SPECTROMETER
V. M. Mamayev 23 Jan. 1967 7 p Transl. into ENGLISH from Russian Patent No. 172116 (Appl. No. 902446/26-25, 26 May 1964) 2 p
(FTD-HT-66-701; AD-650744) CFSTI: HC $3.00/MF $0.65

A nuclear magnetic resonance spectrometer with automatic tuning to the signal maximum is described. The spectrometer contains a polarizing magnet, a detector with a double section coil into which are placed two specimens, a common modulation coil, a modulation unit, a measuring unit, and a meter. To measure continuously the signal difference of the two specimens, the spectrometer contains at the location of the specimens two systems of shift coils which are connected through a control resistor and a measuring device to a dc source. Author (TAB)

N67-29406# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
RECORDING HANDBOOK
James A. Howard and Lester N. Ferguson Dec. 1966 82 p
(Contract DA-28-043-AMC-01829(E))
(EDL-M1096; ECOM-01829-M1096; AD-649812) CFSTI: HC $3.00/MF $0.65

Contents: magnetic recording; tape recorder heads; tape transport mechanisms; electronics; magnetic tape; special techniques and miscellaneous information. TAB

N67-29407# Georgia Inst. of Tech., Atlanta.
CALIBRATION AND DATA REDUCTION OF AN UV SPECTROPHOTOPOLARIMETER
Ellis B. Hodgdon Oct. 1966 146 p refs
(Contract AF 19(628)-5707)
(B-216; SR-1; AFCRL-66-847; AD-650159) CFSTI: HC $3.00/MF $0.65

The purpose of the report is to describe and prove by sample data the procedures for calibration of and data reduction from an ultraviolet spectrophotopolarimeter. The objective of the instrument is to measure the intensity and polarization of skylight radiation at altitudes of greater than 100,000 feet. A brief description is given of the instrumentation package and, in particular, the portions directly involved in the calibration procedure. The body of the report contains the procedures used in optical calibration and the general and specific problems in data reduction. Samples of data have been processed through the data reduction program and the programs have been shown to work. However, overall accuracy and probable error have not been carefully evaluated. Three appendices are included which give details of Stokes vectors and Mueller calculus, derivation of the calibration formulae, and computer programs. Author (TAB)

N67-29417# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
A LOW-FREQUENCY THERMAL FOLLOW BRIDGE FOR MEASURING THE ELECTRO-THERMAL PARAMETERS OF BRIDGEWIRES
James N. Ayres, Louis A. Rosenthal, and Richard A. Maio 17 Mar. 1967 34 p refs
(NOLTR-66-113; AD-650963) CFSTI: HC $3.00/MF $0.65

Advances were made in the art of measuring, nondestructively, the electro-thermal parameters of wire bridge electro-explosive devices. In particular, the thermal-follow phase-shift bridge was redesigned to operate at lower frequencies (approximately 10 Hertz instead of the previous 60 Hertz). Fourfold increases in resolution and accuracy are typical of the lower frequency. Two circuits are described one being battery powered and the other powered from AC mains. Experimental data obtained on one of these circuits are included to show how clearly these measurements detect the presence of explosive in contact with the bridgewire. Author (TAB)

N67-29442# General Electric Co., Syracuse, N. Y. Tube Dept.
CAMERA TUBE WITH INTERNAL IMAGE-MOTION COMPENSATION Final Report, 1 Feb. 1963–15 Nov. 1966
Kurt Schlesinger Ft. Monmouth, N. J., Army Electron. Command, Mar. 1967 142 p refs
(Contract DA-36-039-AMC-00128(E))
(Rept.-14, ECOM-00128-F; AD-649827) CFSTI: HC $3.00/MF $0.65

A three-inch image orthicon with electrostatic motion-compensation was developed and tested. It measures 21-inches overall, of which 7-1/2 inches are taken up by the image-section. Resolution is of the order of 17 line-pairs per mm. Capabilities include the tracking of translatory motion of images projected on photocathode within a 1-1/16 inch circle. In this process, storage gains of over 40db in light-sensitivity have been realized. Image-deflection requires a balanced voltage of 500 volt per terminal. A feedback-dc-amplifier is described which operates on a single-ended input of 10 volts. In circuit, its square-wave response extends beyond 300 kilo-Hertz, including d-c. Image misregistry follows an r to the 3rd power-law with radius (r). Errors of superposition stay below 0.8% and 2.8%, respectively, within areas of 9/16-inch and 1-1/16-inch diameter on photocathode. Several types of test-equipment are described. This includes gating-pulse generators, electronic switches of the type DPDT, and a special film-transport for continuous-motion at one frame per second, complete with synchronous slow-scan circuitry. Author (TAB)

N67-29444# Bausch and Lomb, Inc., Rochester, N. Y.
DEVELOPMENT OF A TERRAIN PROFILE RECORDER IMAGE POINT TRANSFER INSTRUMENT Final Technical Report, Jun. 1965–Jan. 1967
Ronald J. Martino Jan. 1967 27 p
(Contract DA-44-009-AMC-1272(X))
(AD-649830) CFSTI: HC $3.00/MF $0.65

The instrument provides a means of stereoscopically locating and transferring specific points from 35 or 70mm TPR film to 9 in x 9 in or 10 in x 10 in cartographic plates or film. The instrument is table top, convenient to use and was designed for low cost production using many standard components. The accuracy of the marking system is within 2 microns standard deviation error in both X and Y. The most important advancement of this instrument is the successful design of the ruggedized and improved marking system and the improvement of the flagging mark. Author (TAB)

N67-29472# Joint Publications Research Service, Washington, D. C.
CORRELATION FUNCTION MEASUREMENT AND INFRA-LOW FREQUENCY DEVICES—NEW PATENTS
2 May 1967 19 p Transl. into ENGLISH from Russian
(JPRS-40874; TT-67-31516) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. DEVICE FOR MEASURING THE ENVELOPES OF NORMALIZED CORRELATION FUNCTIONS Yu. I. Tuzhilkin p 1–2 (See N67-29473 16-14)

2. PHASE SHIFTER FOR THE INFRALOW FREQUENCY RANGE Ye. D. Koltik and S. A. Kravchenko p 3–6 (See N67-29474 16-09)

3. A DEVICE FOR DETERMINING THE CORRELATION PARAMETERS IN STATISTICAL SAMPLES B. M. Dagayev p 7–9 (See N67-29475 16-14)

4. A METHOD FOR AUTOMATIC MEASUREMENT OF NORMALIZED CURRENT MUTUAL CORRELATION AND AUTOCORRELATION FUNCTIONS OF RANDOM ELECTRIC AND ACOUSTICAL SIGNALS B. G. Belkin p 10–12 (See N67-29476 16-14)

N67-29473# Joint Publications Research Service, Washington, D. C.
DEVICE FOR MEASURING THE ENVELOPES OF NORMALIZED CORRELATION FUNCTIONS
Yu. I. Tuzhilkin *In its* Correlation Function Meas. and Infralow Freq. Devices 2 May 1967 p 1–2 Transl. into ENGLISH from Russian Patent no. 174009, Byul. Izobret. i Tovarnykh Znakov (Moscow), no. 16, 6 Aug. 1965 (See N67-29472 16-14)

A simplified device is proposed in which the undelayed signal is fed via a 90° phase inverter and a limiter-amplifier to a coincidence circuit. A delayed signal is fed to the other input of the circuit from the output of the limiter-amplifier of a correlator. Integrators, detectors, the adder of the detector output signals, and an integrator of the summed signal are attached to the

outputs of the correlator and the coincidence circuit. The detector characteristic is quadratic in the initial segment and linear for values of the envelope close to one. Author

N67-29475# Joint Publications Research Service, Washington, D. C.
A DEVICE FOR DETERMINING THE CORRELATION PARAMETERS IN STATISTICAL SAMPLES
B. M. Dagayev *In its* Correlation Function Meas. and Infralow Freq. Devices 2 May 1967 p 7–9 Transl. into ENGLISH from Russian Patent no. 170700, Byul. Izobret. i Tovarnykh Znakov (Moscow), no. 9, 23 Apr. 1965 (See N67-29472 16-14)

To accelerate the computation process, an electric model of the correlation field is constructed. This is formed by a set of pulse switches or number generators connected in parallel with pulse counters. In the positive number counter circuit, there are ordinary counters; in the sign-variable number circuit, there are reversible counters. The formules used for the calculations are derived. Author

N67-29476# Joint Publications Research Service, Washington, D. C.
A METHOD FOR AUTOMATIC MEASUREMENT OF NORMALIZED CURRENT MUTUAL CORRELATION AND AUTOCORRELATION FUNCTIONS OF RANDOM ELECTRIC AND ACOUSTICAL SIGNALS
B. G. Belkin *In its* Correlation Function Meas. and Infralow Freq. Devices 2 May 1967 p 10–12 Transl. into ENGLISH from Russian Patent no. 168913, Byul. Izobret. i Tovarnykh. Znakov (Moscow), no. 5, 26 Feb. 1965 (See N67-29472 16-14)

In the proposed procedure for obtaining a signal proportional to the normalized current mutual correlation or autocorrelation function, the signals, or the signal and its delayed repetition, are passed through identical controllable amplifiers. The amplification coefficients are automatically regulated so that the mean squares of the investigated signals at the outputs of the amplifiers are kept constant, and the instantaneous values of the output signals of the amplifiers are summed, squared, and integrated. A constant component equal to the sum of mean squares of the investigated signals at the outputs of the controllable amplifiers is subtracted from the obtained signal. Author

N67-29478 Joint Publications Research Service, Washington, D. C.
DESCRIPTION OF SOVIET SATELLITE TRACKING EQUIPMENT
12 Apr. 1967 13 p refs Transl. into ENGLISH from Byul. St. Optich. Nablyudeniya Iskusty. Sputnikov Zemli (USSR), no. 46, 1965 p 22–27
(JPRS-40603; TT-67-31247) CFSTI: $3.00

CONTENTS:

1. INVESTIGATION OF THE CAMERA NAFA-3c/50 V. A. Yurevich p 1–5 refs (See N67-29479 16-14)
2. PHOTOGRAPHIC TRACKING OF SATELLITES WITH THE "LENINGRAD" CAMERA Yu. Pechorin and A. D. Chirtsov p 6–8 ref (See N67-29480 16-14)

N67-29479 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE CAMERA NAFA-3c/50
V. A. Yurevich *In its* Description of Soviet Satellite Tracking Equipment 12 Apr. 1967 p 1–5 refs (See N67-29478 16-14)

A brief description of the serial camera is given, and results of investigations of its lens distortion and estimation of the camera's precision are discussed. Tables of errors caused by the lens distortion are given. The mean square error in determining the star position amounts to 1.4. This camera is better for simultaneous tracking of Echo type satellites than the standard camera NAFA-3c/25. Author

N67-29480 Joint Publications Research Service, Washington, D. C.
PHOTOGRAPHIC TRACKING OF SATELLITES WITH THE "LENINGRAD" CAMERA
Yu. Pechorin and A. D. Chirtsov *In its* Description of Soviet Satellite Tracking Equipment 12 Apr. 1967 p 6–8 ref (See N67-29478 16-14)

To obtain the maximum number of reference marks when photographing an interrupted satellite path with a small size camera, a special multi-vibrator with a period of 2 seconds was installed. This device automatically closes the circuit of electromagnets in the photographic apparatus, by means of which the shutter opening and lens overlapping is achieved. The electromagnet circuit is held closed for one second, then opened for one second, etc. At the moment of circuit closing the lens is being overlapped. Thus, the negative shows the stars and the broken line of the satellite's path. Moments of the start of opening and closing of the lens are recorded on the printing chronograph. Author

N67-29507# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Flight Dynamics Lab.
PRESSURE MEASUREMENT IN THE 10^{-4} TO 10^{-7} TORR RANGE
Vernon L. Mangold Dec. 1966 25 p refs
(AFFDL-TR-66-190; AD-650914) CFSTI: HC $3.00/MF $0.65

The report describes the results of an experimental program to establish the accuracy of pressure measurement in the 0.0001 to 0.0000001 torr range using a calibrated conductance-type pressure measurement system. The data collected during the study is discussed and tabulated. Results of the study indicate that the calibrated conductance-type measurement system investigated can be considered as a standard-type calibration device for the pressure range of 0.0001 to 0.0000001 torr with a maximum uncertainty of 10.3 percent. The difference between the system pressure calculated from measured conditions and a calibrated (McLeod) ion gauge was found to be 3.7 percent maximum in the range 0.00001 to 0.0000001 torr. Author (TAB)

N67-29517# Technical Operations Research, Burlington, Mass.
INVESTIGATION OF ELECTRONIC FRINGE DETECTOR FOR A STELLAR INTERFEROMETER Final Report, 7 Apr. 1966–7 Feb. 1967
John Boardman and Paul Kellen 7 Feb. 1967 46 p ref
(Contract AF 19(628)-5145; ARPA Order 450)
(AFCRL-67-0117; TO-B-67-9; AD-649685) CFSTI: HC $3.00/MF $0.65

A fringe detector was constructed to detect fringes from a Michelson stellar interferometer and to relate these measurements to the characteristics of the source of illumination. A rotating reflector, a single slit, and a phototube were combined to transform the spatially-varying intensity pattern of the fringe field into a time-varying voltage signal displayed on an oscilloscope face. The oscilloscope trace was photographed and analyzed to determine fringe contrast. The maximum sensitivity of the detector was determined to be equivalent to a source providing 10 to the -10th power W/sq. cm at a fringe contrast of 1 and a signal-to-noise ratio of 1. Modifications can provide a factor of 500 to 1000 improvement in detector sensitivity. The interferometer was determined to have potentially better resolution than a single-mirror telescope because it can electrically filter the effects of ambient background illumination and turbulence. The use of an interferometer to measure the angular size of a pie-shaped source was studied and found to be not particularly suited to this purpose. The action

of apodized and unapodized lens systems on the field due to an extended background and a small source was analyzed. Author (TAB)

N67-29674# Naval Research Lab., Washington, D. C.
AIRBORNE INSTRUMENTS FOR TRACER STUDIES IN CLOUDS
E. C. Jones, C. M. Gordon, R. E. Leighton, and J. I. Hoover *In its* Rept. of NRL Progr. Feb. 1967 p 1–7 refs (See N67-29573 16-34)

An airborne instrument system has been developed to disperse, locate, and collect a tracer material for application to cloud physics studies. After collection, the samples are analyzed by neutron activation to detect small amounts of the tracer, in this case indium, that has been dispersed in clouds. The results of the tests indicate that the method shows much promise for future cloud physics studies. Author

N67-29629# ARO Inc., Arnold Air Force Station, Tenn.
INSTRUMENTATION DEVELOPMENT PROGRAM Summary Report
R. H. Hines and F. L. Crossway Arnold Eng. Develop. Center, Apr. 1967 98 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-233; AD-650857) CFSTI: HC $3.00/MF $0.65

The design and operational characteristics of an in-house-built 5-cm-diam Kaufman-type ion engine that was used to evaluate diagnostic methods is presented. The discharge of the ion engine was investigated and analyzed by employing various types of material probes. The emissive probe was used to determine the beam potential, the electron temperature, and the ion impingement current density. The double Langmuir probe was used to determine electron temperature and ion impingement current density for cross correlation between probes. The analytical and experimental results are compared and discussed. Author (TAB)

N67-29638# Electro-Mechanical Research, Inc., Princeton, N. J. Photoelectric Div.
EXTREME ULTRAVIOLET RADIATION DETECTORS Final Scientific Report, 16 Oct. 1964–26 Mar. 1966
Shih-Ping Wang 6 Jul. 1966 131 p refs
(Contract AF 19(628)-4763; ARPA Order 213)
(AFCRL-66-528; AD-650882) CFSTI: HC $3.00/MF $0.65

A workable design of a photoemission spectrometer has been developed following a thorough literature survey, a detailed design study, and a careful electron-optical investigation. The design, construction and experimental work are described along with a review of the results; and several recommendations for continued research investigation are provided. Study and test results on an EUV MPT is summarized. The development and testing of a Windowless Extreme Ultraviolet (EUV) Photon Scintillator demonstrated that the design and operation are both satisfactory and that direct evidences can easily be obtained for two-electron photoemission processes if the quantum yield of the process is sufficiently high. Author (TAB)

N67-29654# ARO, Inc., Arnold Air Force Station, Tenn.
A VACUUM INTEGRATING SPHERE FOR IN SITU REFLECTANCE MEASUREMENTS AT 77°K FROM 0.5 TO 10 MICRONS
B. A. McCullough, B. E. Wood, A. M. Smith, and R. C. Birkebak (Kentucky Univ.) Arnold Eng. Develop. Center, Apr. 1967 27 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-10; AD-650072) CFSTI: HC $3.00/MF $0.65

A modified integrating sphere with a spectral measurement range from 0.5 to 10 microns is described. This integrating sphere can be used for in situ reflectance measurements of low temperature surfaces at vacuum conditions. The techniques employed in measuring the spectral reflectance of CO2 cryodeposits are discussed. Reflectance data for CO2 cryodeposits on stainless steel and Cat-a-Lac Black substrates are presented as a function of wavelength and cryodeposit thickness. The reflectance characteristics of the sphere's internal coating of NaCl are also presented. Author (TAB)

N67-29661# IIT Research Inst., Chicago, Ill. Technology Center.
STUDY TO DETERMINE DESIGN CRITERIA FOR A STEREO FIBER OPTICS PERISCOPE FOR AIRCRAFT APPLICATION Final Report, 11 Apr. 1966–10 Apr. 1967
Harold F. Bennett Apr. 1967 45 p refs
(Contract NOw-66-0439-c)
(AD-651060) CFSTI: HC $3.00/MF $0.65

A program was conducted to investigate the feasibility of substituting a fiber optics periscope system for conventional direct viewing through the windshield in high performance aircraft operation. The requirements for a stereoscopic image presentation possessing time, distance, and spacial relationship are delineated. The stringent specifications imposed on dual fiber bundles by the stereoscopic application led to the successful development of a single-bundle telescope with flicker-free time sharing. A working model to demonstrate the single-bundle, time-shared system was constructed. Methods for providing display systems with long eye relief and large exit pupils are described. A working model incorporating a large spherical mirror was constructed for use with stereo slides to demonstrate these principles. Author (TAB)

N67-29670# System Development Corp., Falls Church, Va.
INFLUENCE OF OVERLAP ON SPEED AND ACCURACY IN SCREENING IMAGERY
N. E. Willmorth Feb. 1967 30 p refs *Its* Tech. Res. Note 180
(Contract DA-49-092-ARO-65)
(AD-649908) CFSTI: HC $3.00/MF $0.65

Student interpreters each screened four rolls of imagery--two of positive transparencies, and two of negative transparencies; one roll with overlap and one without, one of high quality, the other of low quality. Analysis of screening performance yielded seven scores: total time, frame time (average per frame), accuracy, completeness, efficiency, screening errors, and detection errors. The following findings were obtained from the study: (1) With overlap, detection of potentially useful frames required considerably more time, with negligible increase in completeness and no increase in accuracy; (2) Negative transparencies, both with or without overlap, were screened as rapidly as positive transparencies, but with some degradation of accuracy and completeness and an increase in errors; (3) Low quality imagery, both with and without overlap, reduced accuracy and completeness but not screening time; (4) Performance improved significantly from trial to trial. Although the routine use of overlapping imagery does not appear justified in view of the additional screening time required, improved performance from trial to trial suggests that further additional experience with screening may yield improvement in interpreter performance. Author (TAB)

N67-29725# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
DIFFERENTIAL RECOMBINATION CHAMBER [DIFFERENTSIAL'NAYA REKOMBINATSIONNAYA KAMERA]
M. Zel'chinskii and K. Kharnovetskii Jul. 1966 18 p refs In RUSSIAN
(INR-739/XIX/D)

The form of the volt-ampere characteristics of an ionization chamber often depends on the linear energy loss of the particle producing the ionization. This dependence is used in recombination chambers in order to determine the factor of merit or the Q-factor

of mixed radiation. The ratio of the current at a definite voltage of the applied electric field to the saturation current can serve as a measure of the Q-factor which is ordinarily used in determining the dose equivalent. It is convenient to determine the dose directly with a system of three plane electrodes. A central measuring electrode 3 has electrodes 1 and 2 on each side of electrode 3. A sufficiently high voltage is applied to electrode 1 so as to obtain a saturation current in the space between electrodes 1 and 3, where the current is proportional to the dose rate. The voltage applied to electrode 2 is selected in such a manner that the decrease in efficiency of ion collection in the space between electrodes 2 and 3 is linear with increasing Q-factor of the mixed radiation. The difference current is proportional to the product of the dose times the Q-factor. A chamber is designed with 25 electrodes having an electrode thickness of 3 mm and a distance between electrodes of 7 mm. The operating gas pressure is ≈1 atm. The chamber is calibrated with two sources of radiation: ^{60}Co (Q-factor = 1) and a Po–Be neutron source (Q-factor = 7.3). The accuracy of determining the dose equivalent of mixed radiation of unknown origin is ≈20%. The maximum dose rate to be measured is 10 rads/hr. NSA

N67-29738# Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.
PHOTOGRAPHIC EMULSION TRANSFER STUDY
David S. Blethrow Mar. 1967 12 p Prepared for Calif. Univ., Livermore. Lawrence Radiation Lab.
(Contracts AT(29-1)-1183; W-7405-ENG-48)
(EGG-1183-2133; UCRL-13281) CFSTI: HC $3.00/MF $0.65

A technique for removing an exposed photographic emulsion from a nontransparent backing and transferring it to a transparent backing to make it suitable for transparency-type projection is discussed. The requirements were that the emulsion must not be damaged, undergo dimensional distortion, or suffer loss of image resolution. A successful technique was developed using a commercial laminating machine. Efforts to accelerate the process by using a roll-type laminating machine were unsuccessful because the machine selected for test lacked sufficient operating control. Author (NSA)

N67-29803# Solid State Radiations, Inc., Los Angeles, Calif.
FURTHER DEVELOPMENT OF SEMICONDUCTOR DETECTORS FOR GAMMA TRANSIENT DETECTION Final Report
[1966] 61 p refs Prepared for Lawrence Radiation Lab., Calif. Univ., Livermore
(Contract W-7405-ENG-48)
(UCRL-13272) CFSTI: HC $3.00/MF $0.65

The fabrication of semiconductor detectors for gamma transient detection is discussed. Germanium, gold-doped silicon, gallium arsenide, as well as silicon diodes were fabricated and evaluated. Methods of optical dry running of semiconductors were investigated and a pulsed xenon flash lamp was designed for field use. Finally, prototype silicon diodes suitable for application in a high-vacuum photodiode were designed and fabricated. NSA

N67-29838# Sandia Corp., Albuquerque, N. Mex.
PULSED CONSTANT CURRENT GENERATOR
W. A. Stephenson Feb. 1967 11 p
(Contract AT(29-1)-789)
(SC-TM-67-30) CFSTI: HC $3.00/MF $0.65

It is a property of Manganin, as well as other metals, that its electrical resistance increases with an increase in hydrostatic pressure. In order to pursue studies involving the practical use of this phenomena as a shock wave pressure transducer, special instrumentation was developed. To observe the change in electrical resistance of Manganin when dynamic pressure is applied, it is necessary to either hold the voltage constant on a specimen and observe the change in current produced by the resistance change, or to maintain a constant current through the material and observe the voltage change across it. The instrument described is used to provide a pulse of known constant current simultaneously to three Manganin wire shock pressure transducers. Author (NSA)

N67-29843# Japan Broadcasting Corp., Tokyo. Development and Workshop Div.
TWO-INCH IMAGE ORTHICON CAMERA
Kotaro Wakui and Toku Ezawa Feb. 1967 14 p refs
CFSTI: HC $3.00/MF $0.65

A study made of the work involved in setting up a television relay showed that 6 hours were required to transport and assemble the television cameras and field pickup equipment. This led to an evaluation of a compact television camera that is easily carried and assembled by one man in about 1.3 hours. The camera's 2-in image orthicon tube, optical system, configuration, viewfinder, circuit components, and method of assembly are described. The performance of an experimental camera and its systems was tested to determine its possibilities and the results are discussed. Brief mention is made of a more practical design for the compact camera. R.N.A.

N67-29914*# Princeton Univ., N. J. Guggenheim Labs. for the Aerospace Propulsion Sciences.
TRANSIENT PRESSURE MEASURING METHODS RESEARCH Final Summary Technical Report
John P. Thomas and J. P. Layton 31 Mar. 1967 162 p refs
(Contracts NASr-36; NAS8-11216)
(NASA-CR-83584; AMS-595t) CFSTI: HC $3.00/MF $0.65
CSCL 14B

Laboratory evaluations of current transient pressure transducers are presented. Dynamic performance of both uncooled and cooled flush diaphragm transducers of a number of manufacturers is given. Passage connected transducers are evaluated, including the small passage gas bleed technique. Target characteristics for advanced miniature, cooled, flush diaphragm and passage connected pressure transducers are offered. The evaluation methods employed in the laboratory and on the rocket test stand are described. A shock tube for evaluating dynamic performance by computer analysis of oscilloscope photographs is discussed fully. The use of the Princeton sinusoidal pressure generator for transducer system frequency response measurements is presented; this simple device is especially applicable to passage connected and bleed type transducers. The results of pulse tests and subsequent combustion instability on transducer performance are shown. Transduction system and operational considerations are discussed in some detail. Author

N67-29939# Weapons Research Establishment, Salisbury (Australia). Department of Supply.
PHOTOGRAMMETRIC METHODS APPLIED TO WRECISS COMPUTATION
M. J. Collier and B. Beharrell Dec. 1966 27 p refs
(WRE-TN-TRD-22)

A description is given of a method of calculating the position and attitude of a target relative to a missile using data obtained from photographs taken by Weapons Research Establishment Camera Interception Single Shot (WRECISS) cameras situated in the missile. Author

N67-29969 Southampton Univ. (England). Inst. of Sound and Vibration Research.
THE MARK I LINEARISED HOT WIRE ANEMOMETER
P. O. A. L. Davies, P. L. Tanner, and D. Day [1966] 38 p refs
(ISAV-189)

Details are presented on the hot wire amplifier and linearizer, their operation, and probe manufacture. The transistorized hot wire amplifier has a symmetrical bridge unit, two balanced differential

amplifier stages, and two cascaded emitter-follower stages, and is arranged with a separate mains energized stabilized power supply. A small analog computer inverts the nonlinear hot wire output characteristic, providing a linear relationship between voltage output and mass flux past the hot wire probe. The hot wires are formed by copper plating lengths of tungsten wire in a special bath which leaves the active length unplanted, which leaves the active length unplated. The probe assembly is described. Extensive schematics are included. N.E.N.

N67-30003* Aracon Geophysics Co., Concord, Mass.
ARACON PHOTOGRAMMETRIC ATTITUDE SYSTEM DESCRIPTION
Thomas F. Wood, James R. Greaves, and Charles R. Jones, III Jan. 1966 95 p refs
(Contract NAS5-3953)
(NASA-CR-85242) CFSTI: HC$3.00 CSCL 22C

Described is a flexible photogrammetric system to determine attitude of the TIROS wheel satellite from intepretation of its photographs of the earth. Presented are data on the film reader; computational equipment; independent data sources (the horizon, landmarks, and matchpoints) for computer aided attitude estimates; terminology and basic concepts; basic algorithms and the data reduction process; and computer programs for the photogrammetric attitude program. S.C.W.

N67-30013 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE APPLICATION OF THE HARWELL 2000 SERIES ADAPTOR UNITS TO THE DETECTION AND MEASUREMENT OF RADIOACTIVITY
G. F. Snelling Feb. 1967 30 p refs
(AERE-M-1832) HMSO: 4s

This paper describes a range of adaptor units, each capable of being coupled directly to the appropriate type of detector, and yielding analogue output pulses of up to 5 volts amplitude. Proportional counters, semi-conductor detectors and scintillation counters are provided for; a fourth adaptor, for use with NaI scintillation counters, provides stabilization against both temporal drift and drift due to detector temperature variations. Some simple counting systems based upon these adaptors are described, and experimental data given. Author

N67-30044# Weapon Research Establishment, Salisbury (Australia).
W.R.E. TRANSPONDER PEDESTAL-DOPPLER INSTRUMENTATION SYSTEM
A. A. Smith Feb. 1967 64 p refs
(WRE-TN-ISD-80)

An up-to-date description of the complete Doppler instrumentation system now in use at Woomera and Salisbury is given. It includes a description of the pedestal modification and the Mk.2 convertor used for processing the data. Also included is a description of auxiliary systems which use some of the main Doppler equipment. These systems are used for command break-up, timing, and ionospheric research. Author

N67-30117 Japan Broadcasting Corp., Tokyo. Technical Research Labs.
SLOW-MOTION VIDEO TAPE RECORDER
Yukio Kameyama, Haruo Sakata, and Minoru Inatsu Mar. 1967 45 p refs
(NHK-10) CFSTI: HC$3.00/MF$0.65

The slow-motion video tape recorder is based on the 4-head video tape recorder. Tape recorded under standard conditions is slowed to travel at a speed of 1/5; the intermittent signals reproduced by the low speed reproducing special head assembly are recorded in the magnetic 1-field memory; the same field is reproduced 5 times repeatedly and a picture of 5:1 slow-motion results. An instant stop function can stop the picture at any desired moment for still-picture presentation. Motion can be resumed again at any time for continuous slow-motion reproduction. The following new techniques were completed and are described: (1) 1-field memory, (2) high-speed servo control by the magnetic wheel, (3) instant stop system, and (4) field setting. Author

N67-30128*# Kaman Instruments, Austin, Tex.
DEVELOPMENT OF INSTRUMENTATION FOR MEASUREMENT OF BONE DENSITY Final Report
6 Jun. 1967 24 p refs
(Contract NAS9-5880)
(NASA-CR-65643) CFSTI: HC$3.00/MF$0.65 CSCL 06L

Techniques and instrumentation for the quantitative roentgenographic measurement of bone density are described. The roentgenographic technique consists of relating the optical transmittance of a roentgenogram of a bone to its mineral density. The analog computer system is explained as well as the general requirements of bone density instrumentation systems. Alternative instrumentation systems are proposed and an evaluation of the digital system is presented. An accuracy analysis of the digital bone density measurement systems is performed, and system maintenance is described. S.P.

N67-30136*# Kaman Instruments, Austin, Tex.
DEVELOPMENT OF INSTRUMENTATION FOR MEASUREMENT OF BONE DENSITY Phase I Report
10 Jan. 1967 74 p refs
(Contract NAS9-5880)
(NASA-CR-65642) CSCL 06L

Development of a bone density measuring system designed to evaluate the integrated bone density over a specific cross section of bone is discussed. The roentgenographic technique used consists of relating the optical transmittance of a roentgenogram of a bone to the mineral density of the bone. A system utilizing a digital computer was implemented to perform the computation functions similar to those performed by the analog system. Discussions of the digital computer program include method and accuracy of computation; program details; program loading, operation, and output; and computer to densitometer system. System maintenance and circuit documentation are also considered. S.P.

N67-30180*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
DEVELOPMENT OF MECHANIZED ULTRASONIC SCANNING SYSTEM
Raymond Evans and J. A. Mac Donald 22 Jun. 1967 98 p refs
(NASA-TM-X-53598) CFSTI: HC$3.00/MF$0.65 CSCL 14B

This report presents data related to the development and testing of a machanized ultrasonic scanning system for testing butt welds in large aluminum tanks. A significant phase of the project was the design and development of a water column probe. The employment of the water column probe in conjunction with an electronic pulser and recording unit permitted welds to be tested in the same relative time as required for semiautomatic radiography. The results of the ultrasonic scan are recorded for the detection and evaluation of flaw content. The basic configuration of the system along with recordings of various types of flaws are presented and correlated with radiographic and metallographic data. Basic ultrasonic equations are used to demonstrate the practicability for using the technique in testing butt welds. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-29024*# Mechanical Technology, Inc., Latham, N. Y.
STEADY STATE AND DYNAMIC PROPERTIES OF JOURNAL BEARINGS IN LAMINAR AND SUPERLAMINAR FLOW REGIMES. II: FULL-FLOATING-RING BEARINGS
F. K. Orcutt and C. W. Ng Washington, NASA, Jun. 1967 120 p refs
(Contract NASw-1021)
(NASA-CR-733; MTI-65TR33) CFSTI: $3.00 CSCL 13I

Presented is a theoretical analysis of the plain cylindrical, full floating ring bearing with pressurized lubricant supply. Calculated design data are given for the bearing with ratios of inner-to-outer film clearance of 0.7 and 1.3, and for three values of dimensionless supply pressure. These data include laminar and turbulent flow conditions for Reynolds Numbers, based on inner film clearance, up to 9000. Experimental measurements of bearing performance were obtained for correlation with the calculated data. The correlation is good leading to the conclusion that the calculated data are effective for design analysis purposes. The plain cylindrical floating ring bearing was subject to large-amplitude fractional-frequency whirl instability when very low viscosity lubricant (0.65 cs) was used. When a more viscous lubricant (5.0 cs) was used, the whirl amplitudes were small and whirl was suppressed completely by increasing speed beyond the whirl onset speed. Author

N67-29176*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELDING OF PRECIPITATION-HARDENING STAINLESS STEELS
J. J. Vagi, R. M. Evans, and D. C. Martin (Battelle Memorial Inst., Columbus, Ohio) 28 Feb. 1967 195 p refs Prepared by Battelle Memorial Inst., Columbus, Ohio
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53582; RSIC-598) CSCL 13H

The state-of-the-art of the welding of precipitation-hardening stainless steels is reviewed. Welding preparations, specific welding processes, welding dissimilar metals, and joint quality are discussed. Author

N67-29179*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WELDING OF STAINLESS STEELS
H. W. Mishler, R. M. Evans, and D. C. Martin (Battelle Memorial Inst., Columbus, Ohio) 16 Feb. 1967 214 p refs Prepared by Battelle Memorial Inst., Columbus, Ohio
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53576; RSIC-608) CSCL 13H

Welding preparations, specific welding processes, welding of dissimilar metals, and joint quality are discussed. The metallurgical factors involved when welding stainless steels are covered in terms of their metallographic characteristics: austenitic, ferritic and martensitic alloys. Methods of distortion control are discussed. The nonfusion welding processes, solid state welding, brazing and soldering as applied to stainless steels are reviewed. An appendix details the basic characteristics of several welding processes. Author

N67-29200# General Electric Co., Cincinnati, Ohio. Materials Development Lab.
FABRICATION TECHNIQUES FOR TURBINE COMPONENTS
L. P. Jahnke *In* AGARD Gas Turbines 1966 p 381–412 refs (See N67-29181 16-28)

The primary motivations behind the recent evolution of fabrication methods for gas turbine components are described. Examples of the newer and more effective techniques used for direct part consolidation, joining, metal removal and forming are reviewed, showing the equipment required and the hardware which results. Conclusions are drawn about the future trends and the major opportunities which remain to be exploited. Author

N67-29201# Riv-Officine di Villar Perosa S.P.A., Turin (Italy).
ROLLING BEARINGS AND LUBRICANTS FOR HIGH-TEMPERATURE APPLICATIONS, PARTICULARLY IN TURBINE ENGINES
F. Colanzi *In* AGARD Gas Turbines 1966 p 413–431 (See N67-29181 16-28)

Experience in the field of aircraft turbine-engine bearings is briefly summarized. Tests carried out with high-temperature lubricants are reported, together with technical data on the manufacture and lubrication of aircraft turbine-engine bearings. Author

N67-29221# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COLD-STAMPING TECHNOLOGY
A. N. Malov 13 Dec. 1966 714 p refs Transl. into ENGLISH of the book "Tekhnologiya Kholodnoy Shtampovki" Moscow, Oborongiz, 1963 p 1–564
(FTD-HT-66-268; TT-67-61577; AD-650558) CFSTI: HC $3.00/MF $0.65

The production processes of cold pressing of components (blanks) from sheet and shaped stock used in series and mass production of precision machine-building and instrument-making products are considered. Methods of designing and calculating production processes, problems of technological effectiveness of designs, automation of processes, and calculation of press capacities are presented. The various factors which affect the precision of manufactured components are examined, production products and equipment are described, and the reference data necessary for various calculations are presented. Author (TAB)

N67-29382*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
DIFFUSION BONDING OF DISSIMILAR METALS
Charles E. Cataldo *In its* Res. Achievements Rev., Vol. II 1966 p 3–8 (See N67-29381 16-17)

A study of metal joining methods led to the diffusion bonding process using diffusion bonding aids. The diffusion bonding process and construction of diffusion bonded dissimilar metal joints are briefly described. Construction of four tank assemblies by the diffusion bonding process was followed by cycling and burst tests to determine the strength of the bonded joints. Test results on the four tanks are discussed and related to the general use of diffusion bonded alloy combinations. Author

N67-29386*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
MATERIAL DESIGNS FOR ELECTRONIC APPLICATIONS
Eugene C. Mc Kannan and James E. Curry *In its* Res. Achievements Rev., Vol. II 1966 p 23–33 (See N67-29381 16-17)

The development of new materials for fabrication of dc motor brushes is discussed. Considered in the discussion are the wear process as affected by velocity, current density, material fabrication and initial operation. The evaluation of complete motor assemblies emphasizes high contact efficiency, high temperature resistance, and low noise level. A comparison is made on the use of a thin polyimide coating versus a teflon coating for insulating wires in cryogenic environments. The mechanical and electrical

properties of both wire insulation materials are presented. The breakdown voltage (strength) of several liquid cryogens was determined, and the gaseous and liquid breakdown strengths of three cryogens are compared. A theory for the breakdown strengths of the liquid cryogens was formulated which contributes an important link in the basic theory of electrical discharge. The protection of electronic circuitry by potting compounds and coating resins is discussed. The complex materials evolving from experiments in developing potting and coating compounds are provided by combining desirable molecular structures from different polymers and by providing new curing systems. Author

N67-29600# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
INVESTIGATION OF SOLID LUBRICANTS FOR HELICOPTER TRANSMISSIONS Final Report, Jul. 1965–Nov. 1966
Paul H. Bowen Ft. Eustis, Va., Army Aviation Material Labs., Mar. 1967 81 p refs
(Contract DA-44-177-AMC-307(T))
(USAAVLABS-TR-67-4; Rept.-66-9B3-LUBER-R4; AD-650763)
CFSTI: HC $3.00/MF $0.65

The feasibility of using solid lubricants in bearings and gears was demonstrated as a satisfactory method for preventing catastrophic failure and for providing emergency operation of helicopter transmissions in the event of an oil lubrication failure. Modified size-208 Conrad-type ball bearings with retainers of a glass reinforced polyimide, WRP-140, operated initially under a base line condition of oil lubrication for 40 hr. This was followed immediately by 0.5 hr of residual oil lubrication and 1.5 hr with no external lubrication at 14,000 rpm for various thrust loads of up to 800 lb without failure. Bearings with a silver alloy - Teflon composite, RB-HP-15 operated under similar oil and residual lubrication for 0.5 hr at loads of up to 450 lb before failure. A conventional 12 diametral pitch (DP) AISI 9310 gear set, using a 6-in. gear and a 2-in. pinion with a 2.5-in. idler of WRP-140, operated under base line conditions of oil lubrication for 40 hr at approximately 14,000 rpm and at a tooth load of 160 lb (640 lb/in. tooth width (ppi)). Similar gears with the same idler operated 0.5 hr with no external lubrication at a load of 1220 ppi (305 lb tooth load). With an RB-HP-15 idler, other gears were operated without lubrication for 0.5 hr at a load of 1220 ppi. Author (TAB)

N67-29855# Union Carbide Nuclear Co., Oak Ridge, Tenn. Nuclear Div.
A BIDIRECTIONAL PRECOUNTER FOR INTERFACING SMALL COMPUTERS TO MACHINE CONTROL
J. L. Arrowood and W. A. Groppe 28 Mar. 1967 18 p
(Contract W-7405-ENG-26)
(Y-1570) CFSTI: HC $3.00/MF $0.65

Due to the many requirements imposed upon it, the feedback counting system necessary in using a digital computer to control a machine tool is complicated and expensive. A simple, inexpensive circuit was designed which would eliminate some of these requirements by operating upon the feedback signal before it was received by the counter. This provision allows a fairly simple counting system to be used. Author (NSA)

N67-30008* Boeing Co., Seattle, Wash. Launch Systems Branch.
METALLURGICAL ANALYSIS OF ENGINE FAIRING STAGE ATTACH FITTING, 60B16081 FAILURE
C. B. Schwartz [1967] 27 p refs
(Contract NAS8-5608)
(NASA-CR-85234; T5-6539-85) CFSTI: HC $3.00 CSCL 13E

Laboratory tests were conducted to determine the cause of failure of one engine fairing stage attach fitting on the F-vehicle and two fittings on the D-vehicle, respectively. While conditions surrounding the F and D vehicle failures were different, evidence of stress corrosion cracking was found in all three parts. Stress corrosion cracks were caused by unfavorable grain orientation and fit up stresses exceeding the stress corrosion threshold of the 7079-T6 aluminum alloy in the short transverse grain direction. It is concluded that reduction of fit up stresses would eliminate the possibility of stress corrosion cracking in unaffected parts of this type. Author

N67-30056*# Chrysler Corp., New Orleans, La. Space Div.
TEST REPORT FOR RELIEF VALVE 1-1/2 BY 2-INCH, 300 PSIG
31 Mar. 1967 24 p
(Contract NAS8-4016)
(NASA-CR-85264; TR-RE-CCSD-FO-1075-3) CSCL 13K

Results of tests performed on one specimen of relief valve are reported. The following tests were performed: receiving inspection, proof pressure, and functional. A leak developed during proof pressure testing in the protective cover for the adjusting bolt assembly. During the functional test, when pressurized with GN_2 at 50 psig through the inlet port, the specimen leaked through the exit port. No leakage is allowed until 280 psig is attained. The specimen was disassembled and cleaned. When retested, the inlet port was pressurized to 112 psig and the specimen leaked through the exit port. The specimen was returned to the vendor for rework. When the specimen was returned it was again tested and leaked through the exit port when the inlet port was pressurized to 175 psig. Cause of the malfunction was attributed to a defective seat. Testing was discontinued at this point. Author

N67-30069* Chrysler Corp., New Orleans, La. Space Div.
TEST REPORT FOR CHECK VALVE, 12-INCH, MISSION VALVE AND PUMP COMPANY PART NUMBER 12 AMP-248, NASA DRAWING NUMBER 75M04406 PCV-4
17 Feb. 1967 55 p
(Contract NAS8-4016)
(NASA-CR-85253; TR-RE-CCSD-FO-1067-3) CSCL 13K

The check valve is used in the environmental control system and prevents overpressurizing of air conditioning ducts. The valve body is aluminum, the spring is stainless steel, and the seal is Buna-N. The valve has an operating pressure of 150 psig and is designed for use with air or gaseous nitrogen. Two specimens were tested to determine if they meet operational and environmental requirements of the launch complexes. Results of the following tests are presented: (1) proof pressure and functional; (2) high and low temperatures; (3) flow and surge; and (4) life cycle and burst. K.W.

N67-30070* Chrysler Corp., New Orleans, La. Space Div.
TEST REPORT FOR PNEUMATIC CYLINDER, DOUBLE ACTING, PNEUDRAULICS, INC., MODEL 7091, NASA DRAWING NUMBER 75M06911 REV. D
19 Dec. 1966 81 p
(Contract NAS8-4016)
(NASA-CR-85254; TR-RE-CCSD-FO-1065-3) CSCL 13K

The pneumatic cylinder is used on the Apollo access arm installation to control the position of the escape tower hooks. Constructed of stainless steel, the cylinder is rated for use with air or nitrogen at an operating pressure of 1000 psig; when locked in the retracted position, it requires 50 (±10) psig to unlock. Two specimens of the cylinder were tested to determine if they meet operational requirements of the launch complexes. Presented are the results of the following tests: (1) proof pressure and functional; (2) high and low temperatures; (3) surge, vibration, and burst; (4) sand, dust, and salt fog; and (5) life cycle. K.W.

N67-30071* Chrysler Corp., New Orleans, La. Space Div.
TEST REPORT FOR PRESSURE REGULATOR, MAROTTA VALVE CORPORATION PART NUMBER 230844-2, MODEL NUMBER RV74EB, NASA DRAWING NUMBER 75M06302

1 Aug. 1966 123 p
(Contract NAS8-4016)
(NASA-CR-85255; TR-RE-CCSD-FO-1039-3) CSCL 13K

The regulator is designed to reduce an inlet pressure of 4500 psig to an outlet pressure ranging from 750 psig to 2160 psig; it is used to control supply pressure in the Apollo access arm. The regulator is a hand-loaded pneumatic device used with dry air or gaseous nitrogen. Three specimens of the model were tested to determine if they meet operational and environmental requirements of the launch complexes. Presented are the results of the following tests: (1) proof pressure, functional, and flow; (2) high and low temperatures; (3) surge and vibration; (4) sand, dust, and salt fog; (5) life cycle; and (6) burst. K.W.

N67-30080# General Electric Co., Evendale, Ohio. Materials Development Lab. Operation.
INSTALLATION TORQUE VERSUS PERMANENT ELONGATION FOR 5/16-24 THREAD R-41 BOLTS
W. K. Minnich 23 Aug. 1966 11 p
(R66FPD249)

In order to obtain maximum clamping forces, high pressure turbine rotor bolts were torqued 300–320 in-lbs. This value exceeds the recommended 200 to 225 in-lbs. for 5/16"-24 bolts at the 90,000 psi stress level. Some failures occurred in the 300–320 in-lbs. range and the installation torque will be reduced to the recommended 200–225 in-lbs. In tests to determine the maximum safe torque on these bolts, the initial bolt length was measured, a load was applied by tightening a nut on the bolt, and the length of the loaded bolt was measured. The load was removed and the length was again measured for any permanent distortion. This procedure was repeated with incremental increases until the bolts broke. One modified bolt was tested to determine if permanent elongation occurred uniformly through the stressed length or instead was confined to the root diameter portion of the threads. It was found that the use of torque values as low as those listed in Design Practice 14C207 H8 results in permanent elongation of some, but not all, of these bolts at room temperature. Observations of yielding phenomena based on free-length (unloaded) measurements are more sensitive and meaningful than observations on bolts having superimposed elastic loads. K.W.

N67-30089# College of Aeronautics, Cranfield (England). Dept. of Production and Industrial Administration.
THRUST AND STIFFNESS NOMOGRAMS FOR HYDROSTATIC BEARING CALCULATIONS
P. Cooke and A. J. Scarr Aug. 1966 10 p refs
(CoA-NOTE-M+P-13)

Consideration is given to the computation involved in arriving at suitable design parameters for hydrostatic lubrication. Expressions are given for two of the parameters, thrust and stiffness, and it is proposed that presentation of these formulae in the form of nomograms will aid the designer in solving design problems in hydrostatic lubrication more easily and efficiently. Methods for utilizing the nomograms are outlined, and examples are given of each. L.E.W.

N67-30154*# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
ANALYSIS OF A GAS BEARING SYSTEM WITH SHAFT DAMPING FOR STABILITY Final Report, 6 Jun. 1966–6 Jan. 1967
S. V. Lukas Jun. 1967 47 p refs
(Contract NAS3-8516)
(NASA-CR-72246) CSCL 13I

The application of Linde's gas bearing system to a Brayton cycle radial flow turbocompressor was investigated. The most suitable bearing and mount arrangement were selected. The gas lubricated rotor is supported by a non-rotating damped shaft with flexible supports. Journal bearings were analyzed for power loss, centrifugal and thermal growth of the radial clearances, and other performance parameters. A spiral grooved pump-in thrust bearing was analyzed for frictional power loss, load carrying capacity, running gap, and centrifugal and thermal distortion. The system's rigid body critical speeds are above and below the operating speed while the flexural critical speeds of the stationary shaft and rotor are above the overspeed condition of the machine. The stiffness of the flexible supports and shaft damping were determined to ensure journal bearing stability. The study showed that this arrangement can meet the requirements for high threshold of stability, low bearing power loss, long bearing life, and thermal isolation of bearing and support from the housing. The arrangement also provides a simple design, easy alignment, and reduced weight. R.N.A.

N67-30158*# Camin Labs., Inc., Brooklyn, N. Y.
DEVELOPMENT OF ELECTROFORMING TECHNIQUES FOR THE FABRICATION OF INJECTORS Final Report, 21 Jan. 1966–21 Apr. 1967
Sanford S. Hammer 15 May 1967 67 p refs
(Contract NAS9-6177)
(NASA-CR-65641) CSCL 13H

A program was conducted to demonstrate the capability of utilizing electroforming techniques in the design and fabrication of liquid propellant rocket motor injectors. A laboratory scale program was conducted to define and develop the electroforming process variables and techniques required for the successful fabrication of electrodeposited injectors. Multiple doublet and multiple triplet injectors were designed and subsequently approved. Four injectors of each configuration were fabricated and subjected to hydraulic testing to define hardware reproducibility. Results indicate that electroforming techniques are capable of producing injectors having complex internal propellant flow passages, incorporating fewer components and subassemblies devoid of press fits, welds, and brazes with demonstrated reproducible hydraulic characteristics. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-28998# North Carolina State Coll., Raleigh. School of Physical Sciences and Applied Mathematics.
EFFECTS OF GAMMA IRRADIATION ON URANIUM DOPED CALCIUM FLUORIDE, PART II Final Report, 8 Oct. 1965–7 Dec. 1966
Benjamin T. Gravely Dec. 1966 65 p refs
(Contract DA-01-021-AMC-13339(Z))
(AD-650121) CFSTI: HC $3.00/MF $0.65

The effects of Co^{60} and Cs^{137} gamma radiation on the 0.2 microns to 1.1 microns spectral region of $CaF_2:U^{3+}$ were studied. Radiation induced absorption bands formed at 0.320, 0.405, and 0.595 micron appear to be the results of three distinct types of centers. The shape of the band at 0.595 micron indicates that there may be several composite bands in this region. The energy levels of these bands lie between 14,000/cm and 18,000/cm which is just above the quadruplet-I15/2 levels of the imperturbed uranium ions. Decay of the radiation induced center band spectrum due to time and due to optical bleaching with an FX 38A linear flash tube was investigated. The 0.320 micron band decayed less than 15 per cent under flashing, while the 0.405 micron band fell approximately 55 per cent, and the 0.595 micron band fell approximately 45 per cent. The effect of gamma radiation on the laser output of a $CaF_2:U^{3+}$ rod was examined with the help of new low temperature head which could be placed into the sample compartment of the Co^{60} irradiator. An increase of 250 per cent was observed over the unirradiated output. Author (TAB)

N67-29048# RCA Victor Co., Ltd., Montreal (Quebec).
DETERMINATION OF THE VELOCITY DISTRIBUTION IN PLASMAS WITH LASERS BY THOMSON AND BY RESONANT SCATTERING Interim Technical Report, 22 Mar. 1965–1 Mar. 1966
Issie P. Shkarofsky Wright-Patterson AFB, Ohio. ARL. Nov. 1966 85 p refs
(Contract AF 33(615)-2198)
(ARL-66-0234; AD-649664) CFSTI: HC $3.00/MF $0.65

Laser scattering methods that appear promising for deducing the single-particle electron-velocity distribution (as well as density and temperature) are described and compared. Single laser Thomson scattering with KL sub D>>1 and a frequency shift greater than the plasma frequency, is reviewed and shown to be feasible for the velocity range between thermal to three times thermal velocity. Also analyzed are methods involving Thomson scattering off the electron plasma or ion plasma resonance with KL sub D<1. A new method is described using the double-laser method of Kroll et al. to scatter off induced plasma oscillations. The detailed theory is presented for arbitrary distribution functions and with fewer assumptions than in other work. Based on Landau damping, this method is suited for the high-velocity range between 2.4 and 4 times thermal velocity, the upper limit given by collisional damping and hence dependent on density. The best density range is between 10 to the 12th power and 10 to the 13th power/cc. With a N2+CO2+He laser at 10.6 microns, the scattering angles are between 10–20 degrees. For an appreciable scattering angle at lower densities, one requires sources between 126 and 1450 times the plasma frequency, when the electron temperature is 3000°K.
Author (TAB)

N67-29117# Texas Instruments, Inc., Dallas. Apparatus Research and Development Lab.
MULTICOLOR LIGHT DISPLAY Final Report
Charles E. Baker and C. M. Alsabrook Feb. 1967 71 p
(Contract AF 30(602)-3910)
(RADC-TR-66-711; AD-650203) CFSTI: HC $3.00/MF $0.65

The report presents the results of a one-year program to develop a Multi-color Laser Display. The purpose of the development was to demonstrate the feasibility of using lasers to produce the primary spectral lines that, when scanned into the standard 525-line television raster, would produce a color presentation compatible with the NTSC encoded video signals. The basic features of the approach used to accomplish the display is presented along with various parameters of the components such as electro-optic light modulator, acoustic scanner, nodding mirror scanner, and gas lasers. The results of the evaluation of the display are also presented and analyzed, showing the success of the program. Areas for continued work that would improve performance are also discussed.
Author (TAB)

N67-29129# North Carolina State Coll., Raleigh. Physical Sciences Research.
CHARACTERISTICS OF PULSED LASER CRYSTALS AS A FUNCTION OF GAMMA IRRADIATION Final Report
Grover C. Cobb, William C. Collins, William R. Davis, Benjamin T. Gravely, Marvin K. Moss et al Dec. 1966 50 p refs
(Contract DA-01-021-AMC-13339(Z))
(AD-650120) CFSTI: HC $3.00/MF $0.65

A study of the laser characteristics of CaWO4:Nd(3+), CaMoO4:Nd(3+), LaF3:Nd(3+), LaF3:Pr(3+), CaMoO4:Nd(3+):Tm(3+), Y3Al5O12:Nd(3+), and Y3Al5O12:Nd(3+):Cr(3+) was made as a function of gamma irradiation. In particular, the Co60 gamma radiation produced absorption bands were studied for their effects relating to fluorescent efficiency. CaWO4:Nd(3+) and CaMoO4:Nd(3+) showed very little gamma induced center band structure. The efficiency of CaWO4:Nd(3+) decreased substantially as a function of gamma dose; however, the efficiency of CaMoO4:Nd(3+) was only slightly decreased by a total dose of 2 MR. The doped LaF3 crystals showed a substantial gamma induced center band structure. However, only the LaF3:Pr(3+) exhibited interesting laser characteristics. The efficiency of Y3Al5O12:Nd(3+) was increased significantly by gamma irradiation, first appearing at a dose level of 2,000 R and continuing to a total dose of 15,000 R. At a dose of 20,000 R the overall efficiency had decreased slightly.
Author (TAB)

N67-29364# TRG, Inc., Melville, N. Y. Quantum Electronics Dept.
STATUS OF LASER TECHNOLOGY
Richard T. Daly *In* AGARD Orbit Optimization and Laser Appl. Oct. 1964 p 79–108 refs (See N67-29361 16-30)

The laser oscillator is described, and terms used to describe laser operation and performance are included. Laser excitation is mentioned in general terms; and attention is given to the radiance; output time dependence; and spectral width of laser oscillations; optical pumping; and pumping for molecular dissociation, direct electron excitation, and collisions-of-the-second-kind. Homogeneous solid or liquid phase lasers, and junction or semiconductor lasers are discussed, along with rangefinding in the atmosphere and in space and precise meteorology.
M.W.R.

N67-29366# Sylvania Electric Products, Inc., Mountain View Calif. Optics Dept.
LASER RECEIVING SYSTEMS
B. J. McMurtry *In* AGARD Orbit Optimization and Laser Appl. Oct. 1964 p 183–255 refs (See N67-29361 16-30)

Two types of laser receiving systems are discussed. The first type involves direct detection of amplitude-modulated (AM), phase-modulated (PM), or frequency-modulated (FM) light; and the second type involves heterodyne detection of AM, PM, or FM light. The type of heterodyne receiver used depends upon whether the receiver is part of an optical radar system or an optical communications system. In the radar the laser transmitter also provides the local oscillator (LO) for the receiver, whereas in communications the laser transmitter is usually completely independent of the LO. Two types of radar receivers are described. One uses a fixed frequency LO and a broadband photomixer, and the other uses a tracking LO and a narrow band photomixer. Receiving system components such as detectors, filters, amplifiers, and frequency translators are described, with particular emphasis on detectors and mixers. Two experimental systems are discussed. One involves television communication over a microwave-modulated light beam, and the other is an optical heterodyne receiver using automatic frequency control. Quantum mechanical limitations on the channel capacity of a laser communications system are described.
Author

N67-29378*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DEVELOPMENT OF A 10.6-MICRON LASER MODULATOR
T. E. Walsh (RCA, Princeton, N. J.) and E. Hirschmann Washington, NASA, Jun. 1967 13 p refs
(NASA-TN-D-4049) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The advent of the CO_2-laser has generated the need for a 10.6-micron gallium arsenide modulator. A 10.6-micron laser modulator has been constructed which gives 61% depth of modulation for 1000 volts peak modulating signal over a bandwidth from dc to over 20 MHz. Efficient and compact quarter-wave plate and polarizers were developed for use at this wavelength. The modulator, which can be used at wavelengths from 2 to 12 microns, was used to measure the electro-optic coefficient of gallium arsenide throughout the range.
Author

N67-29404# h nu Systems, Inc., Menlo Park, Calif.
LASER PARAMETER MEASUREMENTS HANDBOOK Final Report

H. G. Heard Griffiss AFB, N. Y., RADC, Feb. 1967 298 p refs
(Contract AF30(602)-3346)
(RADC-TR-66-704, Vol. III; AD-650872) CFSTI: HC $3.00/MF $0.65

The handbook is a compendium of measurement that encompasses the laser technology. It includes a wealth of information gleaned from over 650 articles surveyed in an exhaustive literature search that reviewed American as well as foreign scientific journals and government reports. This work contains the contributions of 37 authors whose works were edited to conform with the text and abridged to eliminate redundancy. It is believed that the text treats all of the significant laser measurement techniques that have been published to date in the areas of beam sampling, beam parameters, power, energy, gain, wavelength, bandwidth, coherence and frequency stability. The techniques of modulation and the methods of measurement are treated as are the communication aspects of noise in the laser signal source. This volume contains chapters entitled: Measurement of Bandwidth and Coherence; Measurement of Frequency Stability; Measurement of Noise and Modulation of Laser Carriers. TAB

N67-29422# Army Electronics Labs., Fort Monmouth, N. J.
BROADBAND LASER DIGITAL REFLECTOR
S. Leroy Everett, Jr., Robert A. Cicero, David K. Ruppe Jan. 1967 46 p refs
(ECOM-2795; AD-651220) CFSTI: HC $3.00/MF $0.65

The report describes the design of a broadband laser beam digital deflector feasibility model. This model will be a flexible broadband assembly permitting evaluation of numerous broadbanding techniques. Two methods of externally modifying an existing single wavelength digital deflector are described. Both methods provide a beam deflection system operating throughout the 4500A to 7000A portion of the spectrum. Estimates of light intensity losses are calculated for both methods of external modification. Losses are calculated at the discrete laser wavelength to be used in the Laboratory feasibility model. The theory illustrating the method of compensation required for broadband deflector operation is explained. Sample calculations are included for compensation of a two-color model. Laboratory techniques to facilitate compensation of three- and four-color models are included. Problem areas requiring special investigation are outlined. A literary investigation of index of refraction matching fluids is included as an Appendix. The problems encountered with previously used fluids in the deflector and their possible solutions are discussed. Conclusions and recommendations concerning investigation of problem areas and laboratory fabrication of the feasibility model are given. Author (TAB)

N67-29438*# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
ADVANCED STUDY ON OPTICAL COMMUNICATIONS FROM DEEP SPACE (EXTENSION) Final Technical Documentary Report, 12 Aug. 1966–12 Mar. 1967
12 Mar. 1967 274 p refs
(Contract NAS9-3650)
(NASA-CR-65634) CSCL 20E

Plans for testing optical components of various types of laser communication systems are presented. Materials are selected for testing, and the requirements for both simulated and space flight testing of these materials are presented. A series of communication theory and communication system performance tests are recommended. Details of these tests, required special test equipment, test procedures, and data reduction techniques are explained. Standard test equipment, and ways of implementing these tests are recommended. Predicted results of tests are presented. A computer model to calculate power requirements for deep space optical communications is presented and explained. Sample test results for PPM, PL, and coherent modulation are given. A range tracking system that is compatible with digital television, and has an unambiguous range of 100×10^6 miles is developed. Predictions of its performance during deep space missions are calculated. Author

N67-29445# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
RESEARCH OF SENSITIZED FLUORESCENCE OF RARE EARTH IONS IN CRYSTALS Progress Report, 16 May–6 Dec. 1966
R. C. Ohlmann, N. T. Melamed, R. Mazelsky, and W. E. Kramer Dec. 1966 67 p
(Contract AF 33(615)-5171)
(Rept.-66-9C1-SXTLS-R1; AD-649831) CFSTI: HC $3.00/MF $0.65

The fluorescence of the rare-earth ions, Eu(3+), Nd(3+), Ho(3+), and Tm(3+) in the host materials Y3Al5O12, Ca5(PO4)3F, YAlO3, GdAlO3 are reported along with the excitation in some cases. These data are used to estimate which ions may be sensitized with transition-metal ions in crystals and will lead to low threshold, high efficiency crystalline lasers. It was found that the rare-earth ions in Ca5(PO4)3F and Y3Al5O12 gave fluorescence lines having more narrow spectral widths than in GdAlO3 and YAlO3. The former two are therefore better materials to choose to sensitize to further improve their laser characteristics. The study of the spectra of manganese, vanadium and titanium in Ca5(PO4)3F indicates that Mn(2+) and (MnO4)(3-) show the most promise as being sensitizers of the rare-earth ions in this host. Initial study of the sensitization of the rare-earth ions has not yet led to any positive results. Attempts to dope Y3Al5O12 with ruthenium were unsuccessful indicating ruthenium is probably not a likely candidate for doping the refractory oxides. Author (TAB)

N67-29482# CBS Labs., Stamford, Conn.
DEVELOPMENT OF A HIGH-SPEED LOW JITTER SCANNING TECHNIQUE FOR APPLICATION TO RADAR SIMULATION Final Report, Jan.–Jul. 1966
I. Shim Wright-Patterson AFB, Ohio, AMRL, Nov. 1966 54 p
(Contract AF 33(615)-3458)
(AMRL-TR-66-176; AD-650322) CFSTI: HC $3.00/MF $0.65

A breadboard model scanner was modified to incorporate a six-lens, rotating optical scanning system and sync. pulse generation circuitry. The modified scanner consists of a laser light source, a beam expander, a beam normalizer, a six-lens, air-bearing, rotating optical scanning system, a holder for a 2-inch-wide transparency, a light collector, a photomultiplier assembly, a video amplifier, sync. pulse generation circuits and a high voltage power supply. Using a laser source to generate a small optical spot, a capability of distinguishing 200 1P/MM and 30 shades of grey from light to dark was demonstrated while maintaining the jitter along the sweep and perpendicular to the direction of sweep of one-fourth of a spot diameter. Author (TAB)

N67-29542# Pacific Missile Range, Point Mugu, Calif.
LASER RADAR RETURNS FROM THE LOWER TROPOSPHERE COMPARED WITH VERTICAL OZONE DISTRIBUTIONS
J. L. Kerrey, D. A. Lee, and C. A. Knudsen 27 Mar. 1967 16 p refs
(PMR-TM-67-2; AD-649700) CFSTI: HC $3.00/MF $0.65

Development of operational meteorological applications for laser radars has generally been handicapped by a lack of direct measurements of atmospheric conditions associated with back-scattering of laser pulses. In an attempt to provide an adequate description of the ambient atmospheric structure, operation of a Q-switched ruby laser has been coordinated with simultaneous and near-simultaneous observations from a variety of standard as well as nonconventional meteorological data systems. Significant similarities appear between aerosol-backscattered laser returns from

the lower troposphere and vertical ozone profiles obtained by balloon-borne chemiluminescent ozoneosndes. The ozone profiles aid interpretation of the laser returns and permit improved delineation of atmospheric strata, especially in smoggy air advected from the nearby Los Angeles Basin. Author (TAB)

N67-29593# h nu Systems, Inc., Menlo Park, Calif.
LASER PARAMETER MEASUREMENTS HANDBOOK, VOLUME II Final Report
H. G. Heard Feb. 1967 235 p refs
(Contract AF 30(602)-3346)
(RADC-TR-66-704, Vol. II; AD-650871) CFSTI: HC $3.00/MF $0.65

The Laser Parameter Measurements Handbook is a compendium of measurement that encompasses the laser technology. It includes a wealth of information gleaned from over 650 articles surveyed in an exhaustive literature search that reviewed American as well as foreign scientific journals, and Government reports. This work contains the contributions of 37 authors whose works were edited to conform with the text and abridged to eliminate redundancy. It is believed that the text treats all of the significant laser measurement techniques that have been published to date in the areas of beam sampling, beam parameters, power, energy, gain, wavelength, bandwidth, coherence and frequency stability. The techniques of modulation and the methods of measurement are treated as are the communication aspects of noise in the laser signal source. This volume contains chapters entitled: Measurement of gain parameters; Measurement of wavelength. TAB

N67-29595# h nu Systems, Inc., Menlo Park, Calif.
LASER PARAMETER MEASUREMENTS HANDBOOK, VOLUME I Final Report
H. G. Heard Feb. 1967 387 p refs
(Contract AF 30(602)-3346)
(RADC-TR-66-704, Vol. I; AD-650870) CFSTI: HC $3.00/MF $0.65

The handbook is a compendium of measurement that encompasses the laser technology. It includes a wealth of information gleaned from over 650 articles surveyed in an exhaustive literature search that reviewed American as well as foreign scientific journals, and Government reports. The work contains the contributions of 37 authors whose works were edited to conform with the text and abridged to eliminate redundancy. It is believed that the text treats all of the significant laser measurement techniques that have been published to date in the areas of beam sampling, beam parameters, power, energy, gain, wavelength, bandwidth, coherence and frequency stability. The techniques of modulation and the methods of measurement are treated as are the communication aspects of noise in the laser signal source. This volume contains chapters entitled: Laser parameters and measurement; Beam sampling techniques; Measurement of beam parameters; Measurement of energy and power. TAB

N67-29887# TRW Systems, Redondo Beach, Calif.
ABLATING WALL ANNULAR FLASH LAMP Final Report, Feb. 1966–Jan. 1967
Robert Goldstein, Frithjof N. Mastrup, and William L. Shackleford
Wright-Patterson AFB, Ohio, AF Avionics Lab., Mar. 1967 103 p refs
(Contract AF 33(615)-1072)
(AFAL-TR-67-32; TRW-02245-6010-R000, AD-649969) CFSTI: HC $3.00/MF $0.65

A quartz ablating laser pump was constructed and up to 25 kj energy was discharged into it from a pulse forming network with resultant power, current and voltage shapes which closely approximated rectangular 1 msec pulses. The pumps were used to pump ruby and neodymium laser crystals. A quartz ablating repetition rate lamp was constructed and operated at rep rates up to 30 pulses per second and a power dissipation up to 2.4 kw; lamp operation was for at least a minute. In addition, the lamp was used to continuously excite a 1/4 inch diameter by 3 inch neodymium crystal at rep rates up to 6 pps. The ablating lamp research was a continued study of the plasma physical characteristics of Plexiglas and quartz ablating lamps. The latter lamp was tested with Plexiglas and quartz center rods and without a center rod. Quartz ablating lamps were used to irradiate several rare-earth doped laser crystals. Laser emission below 1.1 microns was observed from some of these rods. In particular, emission at 8465 plus or minus 25 A was obtained from a CaF2 (10% ErF3, 0.5% TmF3) crystal; this emission had never before been obtained using standard flash lamps. Finally, the maximum radiative efficiency of a 30 inch long quartz ablating lamp with a pulse duration of 35 microsec was found to be about 30%. Author (TAB)

N67-29625# North Carolina State Univ., Raleigh. School of Physical Sciences and Applied Mathematics.
STUDIES OF CENTERS PRODUCED IN SAPPHIRE AND RUBY BY GAMMA RADIATION. PART III Final Report
Charles R. Philbrick, Grover C. Cobb, William C. Collins, William R. Davis, Benjamin T. Gravely et al Dec. 1966 112 p refs
(Contract DA-01-021-AMC-13339(Z))
(AD-650122) CFSTI: HC $3.00/MF $0.65

Centers produced by the gamma irradiation of laser crystals are known to strongly affect laser characteristics. The centers produced by gamma radiation in sapphire and ruby crystals were studied using several experimental techniques. The optical absorption of gamma-radiation-induced center bands was studied using plane polarized light to investigate the optical properties along axes perpendicular and parallel to the C-axis. This technique permits determination of the anisotropy of the radiation-produced centers. The detailed studies of the optical center bands contributed to the identification of the various components of the center band structure. In addition, the results of studies of glow curve measurements, thermoluminescent emission spectra, electrical conduction and step annealing are reported and discussed for the case of centers produced in ruby and sapphire crystals by gamma radiation. Also, the thermal activation energies of the traps associated with the sapphire centers were calculated by three different methods and found to be in good agreement. Author (TAB)

N67-29666# Sylvania Electric Products, Inc., Mountain View, Calif. Electric Defense Labs.
TECHNIQUES FOR SUPER-MODE OSCILLATION Interim Engineering Report, 1 Jan.–31 Mar. 1967
Russell Targ, D. E. Caddes, and P. J. Titterton Mar. 1967 47 p refs
(Contract AF 33(615)-2884)
(IER-7; AD-649903) CFSTI: HC $3.00/MF $0.65

The report discusses a modulation procedure which will be used to obtain pulsing, mode-locked operation from the CO2 laser. An analysis is presented to explain the mechanism by which multimode output from this normally single-frequency laser is obtained. An estimate is given of the enhancement in peak pulse power to be expected, as compared with the previous cw laser power. An analysis is also given for possible mode-locked or FM operation of the GaAs diode laser. Author (TAB)

N67-29672# Brandeis Univ., Waltham, Mass.
QUANTUM THEORY OF INTERNALLY MODULATED LASERS Scientific Interim Report
Paul J. Titterton Feb. 1967 132 p refs
(Contract AF 19(628)-5833)
(SR-4; AFCRL-67-0119; AD-649851) CFSTI: HC $3.00/MF $0.65

Recent experiments have revealed two distinct modes of operation of the internally modulated laser, the am and fm modes, each of which removes almost all random phase and amplitude

fluctuations in the laser output. A quantum theory of the modulation process is developed in terms of the travelling wave modes of an optical resonator. The theory predicts the effect of the modulator on an arbitrary wave packet of electromagnetic energy. A saturation analysis of the steady state operation of both the am and the fm laser is performed in an effective linear response approximation. Effective gain curves are found and plotted for multimode am, single mode am and single mode fm cases. Experiments are suggested to test details of the modulation process whose effects are revealed by this analysis. Author (TAB)

N67-29678# Naval Research Lab., Washington, D. C.
LASER MATERIALS RESEARCH Memorandum Report
H. W. Gandy, R. J. Ginther, and J. F. Weller Jul. 1966 85 p refs
(ARPA Order 306; ARPA Order 660)
(NRL-MR-1713; AD-649670) CFSTI: HC $3.00/MF $0.65

Studies of non-radiative energy transfer in doubly and triply activated glasses are reported. The utilization of this energy transfer in stimulated emission processes in these glasses has been investigated and has yielded expected benefits as well as somewhat unexpected results. Some of these effects are: mutual quenching of coactivator luminescence preventing the stimulated emission of either activator species, controllable selection of the lasing species in doubly and triply activated glass, internal or self Q switching, and ultraviolet radiation-induced modulation of stimulated emission. Author (TAB)

N67-29837# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
INDUSTRIAL LASER POSITIONING APPLICATIONS
R. W. Schede 6 Mar. 1967 22 p refs Presented at the Am. Ordnance Assoc., Std. and Metrology Div. Meeting, Gaithersburg, Md., 12–13 Apr. 1967
(Contract W-7405-ENG-26)
(Y-DA-1587; CONF-670404-1) CFSTI: HC $3.00/MF $0.65

The basic characteristics, operational characteristics, accuracy, machine mounting, and performance of the laser interferometer are discussed. NSA

N67-30020# Marine Engineering Lab., Annapolis, Md.
EXPERIMENTAL TECHNIQUES FOR MEASURING VIBRATIONS USING A LASER INTERFEROMETER
R. A. Darby Mar. 1967 54 p refs
(TM-9/67; AD-650720) CFSTI: HC $3.00/MF $0.65

Existing and some apparently novel experimental techniques for measuring vibrations by use of a HeNe gas laser interferometer are evaluated. Schemes for obtaining accurate, absolute measurements of displacements less than 100 A, such as used in calibrating accelerometers, are considered as well as are methods of scanning a vibrating surface in order to obtain its dynamic displacement profile, as is often desired in acoustic radiation studies. The effect of intensity fluctuations of the light source, variations of the medium in the optical paths, background vibrational noise, and other phenomena are evaluated by comparison of the theory with measurements made on both a vibrating elastic plate and a vibration shake table. It is shown that experimental measurements at low displacements (<<1938 A) can be compared with theory without resorting to statistical evaluations of instrument error and undesired time-variant parameters. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-28996# Battelle Memorial Inst., Columbus, Ohio.
DEVELOPMENT AND APPLICATION OF METHODS FOR ANALYSES OF RESEARCH MATERIALS Final Technical Report, Feb. 1962–Nov. 1966
William M. Henry and Richard E. Heffelfinger Wright-Patterson AFB, Ohio, ARL Jan. 1967 62 p refs
(Contract AF 33(657)-8108)
(ARL-67-0002; AD-649761) CFSTI: HC $3.00/MF $0.65

The report describes the effort on research and development on analytical characterization of a variety of metallic and ceramic materials. Materials studied in this effort included zirconia, hafnia, thoria, yttria, chromium, iron, tungsten, molybdenum, nickel, aluminum, copper, and platinum and various mixtures, compounds, or alloys of the materials. The studies included trace characterizations, stoichiometric measurements, diffusion analyses, and alloy identification. Materials prepared in support of the sponsor program include W-Mo alloys, hypereutectic zirconium carbide, and size fractionated powders. This report describes the analytical methods developed and used on sponsor materials and the results obtained. Author (TAB)

N67-29031*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
STABILIZATION OF CARBON AND NITROGEN IN STAINLESS STEEL AND ITS EFFECT ON MASS TRANSFER IN A STAINLESS STEEL—Cb–1Zr POTASSIUM SYSTEM
R. W. Harrison Washington, NASA, Jun. 1967 38 p refs
(Contract NAS3-6012)
(NASA-CR-806) CFSTI: HC $3.00/MF $0.65 CSCL 11F

An investigation was conducted on the corrosion mass transfer of elements from stainless steel to a refractory alloy in a potassium environment, to expand knowledge on the possible use of these materials in space power conversion systems. A comparative investigation of titanium stabilized alloy (Type 321SS) and a non-stabilized alloy (Type 316SS) was performed to determine whether the titanium addition would reduce or eliminate interstitial element mass transfer in a stainless steel–Cb–1Zr–liquid potassium system. Columbium–1% zirconium alloy specimens were exposed to liquid potassium for 1000 hours at 1400°F under isothermal conditions. Post test vacuum fusion and combustion conductivimetric analyses, for nitrogen and carbon, showed evidence of extensive mass transfer in Cb–1Zr–Type 316SS capsules. No detectable interstitial increase was found in the Cb–1Zr specimens exposed in Type 321SS capsules. Changes in room temperature and high temperature mechanical properties of the Cb–1Zr alloy specimens were consistent with the observed changes in chemical composition. R.U.

N67-29065# Michigan Univ., Ann Arbor. Dept. of Chemical and Metallurgical Engineering.
THE PLASTIC DEFORMATION OF MAGNESIUM
E. W. Kelley (Ph.D. Thesis) and W. F. Hosford, Jr. Feb. 1967 102 p refs
(Contract DA-31-124-ARO-D-321)
(Rept.-07164-1-T; AD-650748) CFSTI: HC $3.00/MF $0.65

Deformation studies were conducted at room temperature on single crystals and textured polycrystals of magnesium and magnesium alloys with thorium and with lithium. Single crystals oriented to suppress shear on the easily activated basal slip systems were deformed by plane-strain compression. Compression along the c-axis was accommodated by <10-11> banding. Compression perpendicular to the unconstrained c-axis activated <10-12> twinning, and, after virtually complete twinning, deformation continued by <10-11> banding in the twinned material. Compression perpendicular to the constrained c-axis was accommodated by the simultaneous operation of <10-12> twinning against the constrain and <10-11> banding. Although this orientation was favorable for <10-10> <12-10> prism and <10-11> <12-10> pyramidal slip, these modes were not

observed in pure magnesium or in Mg-.5%Th. However, <10-10> <12-10> prism slip was active in crystals of Mg-4%Li during compression perpendicular to the constrained c-axis. Fracture in all materials occurred parallel to <11-24> or <10-11> depending on the orientation and composition of the specimen. Author (TAB)

N67-29070# ARO, Inc., Arnold Air Force Station, Tenn.
NITROGEN TETROXIDE–STAINLESS STEEL CRYOPANEL CORROSION AND COATING DEGRADATION IN SPACE CHAMBER PROPULSION TESTING Technical Report, Oct. 1965–30 Jun. 1966
P. G. Waldrep Arnold Eng. Devel. Center, Apr. 1967 34 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-226; AD-650690) CFSTI: HC $3.00/MF $0.65

Corrosion of cryopanel metals in space simulation chambers caused by contamination by fuels, oxidizers, or exhaust gases arising from propulsion systems testing may be a serious problem. Since data taken under operational conditions is needed, a preliminary study using nitrogen tetroxide and 300-series stainless steel was initiated. The temperature was cycled between ambient conditions and 77K, and the pressure between 4 and 0.00001 torr of oxidizer. A black epoxy film covered some of the samples. Welded stainless steel 304 sustained general corrosion with some pitting, and intergranular corrosion was detected in heat-sensitized weld areas. Epoxy coated stainless steel 304 samples demonstrated no apparent damage in one series of short tests, but pit formation in the coating, pitting beneath the coating, and intergranular corrosion in weld areas was detected in a longer test. Heat-treated and polished stainless steel 304-L pitted to an indeterminate depth. An epoxy coated sample of similar material suffered microscopic cracking and blistering of the coating and surface pitting beneath. Author (TAB)

N67-29081# ManLabs, Inc., Cambridge, Mass.
THERMODYNAMIC PROPERTIES OF HCP IRON AND IRON RUTHENIUM ALLOYS
Gerald L. Stapakoff and Lawrence P. Kaufman Apr. 1967 37 p refs
(Contract Nonr-2600(00))
(TR-13; AD-650151) CFSTI: HC $3.00/MF $0.65

Specific heat measurements on a series of hexagonal close packed iron-ruthenium alloys was performed between 60K and 300K. Measurements of the vapor pressure of iron over fcc and hcp iron-ruthenium alloys was performed at 1600K. The results were employed to describe the lattice stability of hcp iron and the thermodynamic properties of the iron-ruthenium system for comparison with earlier results estimated on the basis of high pressure and martensitic transformation data. In support of the theoretical conclusions deduced earlier, and in contrast to present views, the vibrational entropy of hcp iron exceeds that of the bcc form of iron. Author (TAB)

N67-29173*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THERMAL AND MECHANICAL TREATMENTS FOR PRECIPITATION-HARDENABLE STAINLESS STEELS AND THEIR EFFECT ON MECHANICAL PROPERTIES
C. J. Slunder, A. F. Hoenie, and A. M. Hall (Battelle Memorial Inst., Columbus, Ohio) 20 Feb. 1967 204 p refs Prepared by Battelle Memorial Inst., Columbus, Ohio
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53578; RSIC-600) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The treatments employed in the production and fabrication of stainless steels are discussed. Particular emphasis is directed to the interaction of the processing variables and their effects on fabricability and mechanical properties. Equipment and procedures are described as well as problems likely to be encountered and precautions to be observed in processing. Detailed processing information is presented for the precipitation-hardenable stainless steels considered to be applicable for missile and aerospace applications. Author

N67-29174*# Aerojet-General Corp., Sacramento, Calif. Research and Technology Operation.
INVESTIGATION OF N_2O_4 ENVIRONMENTAL EFFECTS ON SPECIALLY HEAT-TREATED Ti–6Al–4V ALLOY Final Report
[1966] 25 p ref
(Contract NAS9-6015)
(NASA-CR-65635) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The mechanical properties and N_2O_4 stress corrosion resistance of standard and extra-low interstitial Ti–6Al–4V alloy were compared in three conditions of heat treatment. The heat treatments studied were the conventional solution-anneal-and-age and two duplex treatments which included controlled-rate cooling from above the beta transus temperature followed by the conventional treatment. The duplex treatments produced an acicular rather than an equiaxed alpha phase. Tensile properties were measured using unnotched sheet specimens. Similar specimens were used to evaluate stress-corrosion resistance at applied stress levels between 85 and 130 ksi. The specimens were subjected to N_2O_4 under a pressure of 250 psig and at temperatures of 105 and 160°F until failure occurred or a maximum of 30 days. Fracture toughness was evaluated qualitatively using precracked Charpy impact specimens. Author

N67-29177*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SURFACE TREATMENTS FOR PRECIPITATION-HARDENABLE STAINLESS STEELS
A. M. Hall (Battelle Memorial Inst., Columbus, Ohio) 27 Apr. 1967 62 p refs Prepared by Battelle Memorial Inst., Columbus, Ohio
(NASA Order H-76715; Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53603; RSIC-595) CSCL 11F

The treatments covered are hard surfacing, electroplating, electroless plating, carburizing and decarburizing, nitriding, burnishing and other finishing operations, explosive hardening, planishing, and peening. Each treatment is described and its application to the precipitation-hardenable stainless steels is discussed. Reasons for using the treatments are discussed, problem areas are identified, and recommendations for research are made. Author

N67-29202# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
DEVELOPED MATERIALS FOR TURBOMACHINE COMPRESSORS [LES MATERIAUX EVOLUES POUR LES COMPRESSEURS DE TURBOMACHINES]
R. Brunetaud *In* AGARD Gas Turbines 1966 p 435–448 In FRENCH; ENGLISH summary (See N67-29181 16-28)

Operational environments for components of advanced concept turbomachine compressors are discussed in terms of materials presently available and material characteristics that must be developed. Improved titanium alloys as well as beryllium and composite materials with a boron or graphite fiber base are considered to produce the necessary weight reduction in compressor blades and to do away with brittleness problems. Refractory nickel base alloys and high strength steels are also mentioned as promising materials. Design and utilization are discussed in this overview of materials development; and thermal fatigue, corrosion stress, and shock resistance requirements are noted. Transl. by M.W.R.

N67-29381*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
RESEARCH ACHIEVEMENTS REVIEW, VOLUME II

1966 62 p refs
(NASA-TM-X-53610; Rept.-4) CFSTI: HC $3.00/MF $0.65 CSCL 11F

CONTENTS:

1. DIFFUSION BONDING OF DISSIMILAR METALS C. E. Cataldo p 3–6 (See N67-29382 16-15)
2. STRESS CORROSION C. E. Cataldo p 7–14 (See N67-29383 16-17)
3. EVALUATION OF MATERIALS BY NON-DESTRUCTIVE MEANS R. L. Gause p 15–21 (See N67-29384 16-17)
4. MATERIAL DESIGNS FOR ELECTRONIC APPLICATIONS E. C. Mc Kannan and J. E. Curry p 23–33 (See N67-29385 16-15)
5. NON-METALLIC MATERIALS J. E. Curry p 35–48 refs (See N67-29386 16-18)

N67-29383*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
STRESS CORROSION
Charles E. Cataldo *In its* Res. Achievements Rev., Vol. II 1966 p 7–14 (See N67-29381 16-17)

This article recounts briefly some of the more critical stress-corrosion failures that have been experienced at Marshall Space Flight Center and the corrective action taken. Some of the recent stress-corrosion studies are described and preliminary results tabulated. Specific problems described are the H-1 Engine LOX dome, the pneumatic line fitting sleeve problems and the more recent problem with wave springs used on MF-flared tube fittings. The use of nitric oxide in preventing stress–corrosion failures in titanium tanks is also discussed. Author

N67-29384*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF MATERIALS BY NON-DESTRUCTIVE MEANS
Raymond L. Gause *In its* Res. Achievements Rev., Vol. II 1966 p 15–21 (See N67-29381 16-17)

The factors that result in a failure caused by stress corrosion are discussed and the various methods used to detect stress corrosion are mentioned. The role of nondestructive testing in solving the stress corrosion problem is outlined. Experimental techniques that may be capable of detecting and measuring stress corrosion and residual stress are discussed. In addition, equations are given for the ultrasonic wave propagation in an anisotropic medium. Author

N67-29437*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE MAKING OF STAINLESS STEEL SHAPES BY CASTING AND POWDER METALLURGY
J. G. Kura, V. D. Barth, E. T. Hall, W. H. Safranek, and H. O. McIntire 16 Feb. 1967 217 p refs Prepared by Battelle Mem. Inst.
(Contract DA-01-021-AMC-11651(Z))
(NASA-TM-X-53577) CSCL 13H

The state of the art of making shapes of stainless steel by casting and by powder metallurgy methods is reviewed. Use of stainless steel powders to make parts is increasing rapidly. Chemical vapor deposition and electroforming were considered in the study but they are not being used for making stainless steel parts. An appreciable amount of developmental work would be required before they could be used. Author

N67-29486# Institute of Modern Languages, Inc., Washington, D. C.
ELECTRON-MICROSCOPE INVESTIGATION OF THE SYSTEM OF ALLOYS Al–Zn–Mg [ELEKTRONNOMIKROSKOPICHESKOYE ISSLEDDOVANIE SISTEMY Al–Zn–Mg]
V. B. Spiridonov, T. A. Vlasova, and V. N. Iordanskiy Ft. Belvoir, Va., Army Eng. and Res. Devel. Labs., Apr. 1967 5 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 8, Aug. 1966 p 6–11
(Contract DA-44-009-AMC-1563(T))
(T-1901-67; TT-67-61618; AD-650909) CFSTI: HC $3.00/MF $0.65

Two methods can be recommended for decreasing the tendency of an alloy to corrode under stress. (1) Decrease of the concentration of vacancies before aging by reducing the rate of cooling during hardening or by increasing the aging temperature with obligatory introduction into the alloy of the proper amount of elements (Cr, Mn, Fe, Si, Ti, Zr, etc.) which yield insoluble intermetallides during heating for hardening. However, this method leads also to a lowering of the strength characteristics. Regulation of the concentration of vacancies by changing the hardening temperature is not discussed here, since the choice of temperature is influenced by a number of technological factors. (2) Increase of the concentration of vacancies, and, consequently, provision for a more dispersed and uniform decomposition by means of the introduction of elements which increase the 'solubility' of vacancies (Zr, Ti, Sc, Cu, Ag). Evidently a combination of the two methods is expedient for obtaining the optimal complex of properties of the considered alloy types. Besides, one should take into consideration the indirect positive effect of admixtures of the recrystallization temperature and the increase of the length of the grain boundaries connected therewith. TAB

N67-29501# Carnegie Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy and Materials Science.
THE MECHANICAL PROPERTIES OF CERAMIC ALLOYS Final Report
G. W. Groves 31 Feb. 1967 5 p
(Contract Nonr-760(28))
(AD-649823) CFSTI: HC $3.00/MF $0.65

Results pertaining to an investigation of crack propagation in ceramic crystals are presented in summary form. TAB

N67-29645# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
INVESTIGATION OF PRECIPITATES IN TWO CARBON-CONTAINING COLUMBIUM-BASE ALLOYS Technical Report, Jul. 1963–Sep. 1965
F. Ostermann and F. Bollenrath (Inst. of Tech.) Dec. 1966 69 p refs
(AFML-TR-66-259; AD-649988) CFSTI: HC $3.00/MF $0.65

The precipitates in the commercial columbium alloys D-31 and D-43 were investigated after various heat treatments. The titanium-rich and zirconium-rich monocarbides are the only stable precipitate phases in alloys D-31 and D-43, respectively. The temperatures for complete solid solution are 1600C for alloy D-31 and 1700C for alloy D-43 corresponding to a carbon content of about 0.09 wt.-%. Non-equilibrium columbium carbides precipitate even during quenching from solid solution, so that no appreciable carbon supersaturation can be achieved in columbium alloys. During aging, the stable monocarbides form at the expense of the non-equilibrium columbium carbides but not from solid solution. Therefore, age-hardening caused by stable MC-phase precipitation does not occur. The effect of oxygen on carbide precipitates was investigated by increasing the oxygen concentration of the alloys on purpose. Oxygen behaved differently in both alloys with respect to precipitate phases. A columbium carbide phase with unknown lattice structure but a composition corresponding approximately to Cb3C2 was found in both alloys after suitable heat treatments. Author (TAB)

N67-29657# Naval Research Lab., Washington, D. C.
BONDING OF THE OXIDES OF HIGH TEMPERATURE ALLOYS Final Report

A. L. Pranatis and M. R. Achter 6 Mar. 1967 12 p refs
(NRL-6516; AD-649841) CFSTI: HC $3.00/MF $0.65

Tensile tests of the bonds formed by sintering together preoxidized metal surfaces indicate that the rate of oxide bonding is determined principally by the rate of metal ion migration through the oxide. For the nickel-base alloys, Inconel X, Inconel 600, Udimet 500, and Udimet 700, for which the oxide is essentially Cr_2O_3, the strengths of the bonds are all of the same magnitude, and secondary alloying additives have only a slight effect. The rate of bonding increases with temperature and decreases as the thickness of the scale formed by preoxidation is increased. TAB

N67-29712 General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
INFLUENCE OF BORON ON THE CREE-RUPTURE PROPERTIES OF A NEUTRON IRRADIATED PRECIPITATION HARDENING IRON BASE ALLOY
J. Moteff, A. J. Lovell, F. D. Kingsbury, and J. P. Smith [1966] 62 p refs Presented at Am. Soc. for Testing and Materials, 69th Ann. Meeting, Atlantic City
(Contract AT(30-1)-2847)
(GE-TM-66-6-15; CONF-660627-14) CFSTI: HC $3.00/MF $0.65

The 650°C stress-rupture strength and ductility of an Fe-base precipitation-hardening alloy (A-286) have been found to be appreciably reduced by neutron irradiation in the neutron fluence range 1.8 to 6.5×10^{20} nvt (thermal) and 4.8 to 7.2×10^{19} nvt ($E_n \geq 1$ MeV). The loss in stress-rupture strength of irradiated A-286 alloy was found to be proportional to the fast neutron fluence level. The loss in stress-rupture strength became greater for those specimens containing the least amount of B. However, the strength of irradiated specimens containing the greater amount of B does show a decrease at the higher fluence level (7.2×10^{19} nvt). The loss in stress-rupture strength of this (A-286) precipitation-hardening alloy was not directly related to the increase in He concentration (i.e., product of B concentration and thermal neutron fluence level) as has been observed to occur in some of the other high-temperature alloys for these test conditions. NSA

N67-29713# Ohio State Univ. Research Foundation, Columbus.
EFFECTS OF SURFACE PREPARATION IN THE STRESS CORROSION CRACKING OF STAINLESS STEEL
R. W. Cochran and R. W. Staehle Oct. 1966 117 p refs
(Contract AT(11-1)-1319)
(COO-1319-48) CFSTI: HC $3.00/MF $0.65

The effect of surface preparation on the incidence of stress corrosion cracking of Type-310 stainless steel was investigated. Wire specimens were used and exposed to boiling $MgCl_2$. Surfaces were prepared by mechanical polishing at three levels of roughness, chemical polishing, vacuum annealing, and electrochemical polishing. A wire range of mean-times-to-cracking was noted. Mean times differed by about a factor of five. Distribution of cracking times also varied about the mean values. Mechanically polished specimens cracked in shorter times than those chemically polished or vacuum annealed. The data were rationalized in the terms of probability of forming chemically active slip steps. Author (NSA)

N67-29718# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
DIFFRACTION CONTRAST AT PLANAR INTERFACES OF LARGE COHERENT PRECIPITATES
A. J. Ardell Jan. 1967 21 p refs
(Contract AT(04-3)-221)
(CALT-221-28) CFSTI: HC $3.00/MF $0.65

Fringe contrast has been observed by transmission electron microscopy at the interfaces of large, coherent γ' precipitates in an aged Ni–6.71 wt % Al alloy. The fringes display characteristic δ-fringe symmetry; they are antisymmetrical in bright field and symmetrical in dark field. In addition, specific extinction conditions are satisfied; whenever the diffraction vector, $\vec{g}$, lies in the plane of the interface, fringe contrast vanishes at that interface. A model describing the lattice distortions near the γ'-matrix interface is considered in detail. This model is consistent with the extinction conditions and accounts for the difference between the excitation errors of the precipitate and matrix which produces δ-fringe contrast. Also, the model correctly predicts the nature of the fringes (i.e., bright or dark) at the top and bottom of the foil. Author (NSA)

N67-29728# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
A RESEARCH PROGRAM ON THE EFFECT OF SUBSTRUCTURE ON THE IRRADIATION STABILITY OF ASTM A302 GRADE B STEEL Quarterly Progress Report
T. A. Trozera and P. W. Flynn 20 Jan. 1967 14 p
(Contract AT(04-3)-167)
(GA-7618; EURAEC-1807; QPR-7) CFSTI: HC $3.00/MF $0.65

The ambient temperature irradiation capsules have been assembled and irradiated or are awaiting insertion. Heater performance and temperature in a section of the elevated temperature capsule were checked. The NDT shift for warm-worked A302-B steel was found to be in excess of 200°C. Electron transmission microscope examination of quenched and tempered and two cold-worked and heat-treated conditions has not revealed observable differences in structure. Author (NSA)

N67-29734# Institut de Recherches de la Siderurgie, Saint-Germain-en-Laye (France).
STUDY OF THE BASE METAL INTENDED FOR RESEARCH ON THE BRITTLE FRACTURE OF LARGE WELDMENTS Final Report
Dec. 1966 62 p
(Contract EURATOM-031-64-5 TEEF(RD))
(EURAEC-1788; EUR-3330; FR-1) CFSTI: HC $3.00/MF $0.65

The mechanical properties, including tensile strength and brittle fracture strength, structural transformations, and stress relief of Super-Elso steel (Ni–Cr–Mo steel) and AMMO steel (Mn–Mo–V steel) were investigated. Quenched and tempered Super-Elso steel (130 mm thick) had a fracture strength of about 80 kg/mm^2 and was chemically and structurally homogeneous throughout. Appreciable differences were found between the brittle fracture strength of the core and skin. Austenite transformation tests showed that the quenchability of this steel is high as regards stress relief. Normalized and tempered AMMO steel (200 mm thick) had good chemical homogeneity throughout; however, there was a 7 kg/cm^2 variation in the fracture load between the skin and the core. The transformation curves showed slight quenchability. NSA

N67-29735# Metaalinstituut TNO, Delft (Netherlands).
A NEW DETERMINATION OF THE EMBRITTLEMENT IN STEEL USING SMALL SPECIMENS (~0.2 cc) IN PARTICULAR WITH RESPECT TO IRRADIATION Progress Report, 1 Oct.–31 Dec. 1966
H. C. van Elst 20 Jan. 1967 36 p
(Contract EURATOM-060-64-11-TEEN)
(EUR-3334; EURAEC-1794; PR-M-67-71-50005) CFSTI: HC $3.00/MF $0.65

Determination of the embrittlement of 4 pressure vessel steels (Soudotenax 58, HSB 55 C, 1.2 MD 07, T_1) after increasing neutron radiation fluences between ca 1×10^{18} and ca 0.5×10^{21} $n \times cm^{-2}$ at 80 degrees centigrade by performance of the stress wave attenuation test was completed. The increase in arrest temperature, according to the results of this test, using several criteria for indicating the transition temperature, was evaluated. This increase of the arrest (transition) temperature at the highest neutron fluence was different for the different steels (it varied between ca 50 and 100 degrees centigrade); its tendency towards saturation depended on the steel. A comparison with available notch impact tests from investigations of the RCN-Petten, Netherlands, was possible for two steels (1.2 MD 07 and T_1).

The tendency towards saturation in the increase of the arrest (transition) temperature was more pronounced in the results of the stress wave attenuation tests than in that of these notch impact tests. Consequently, the prediction of this increase according to the first test, became smaller at the higher neutron fluence values than according to the second test. Author (NSA)

N67-29736# Battelle Memorial Inst., Geneva (Switzerland).
RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION Quarterly Report, 1 Jul.–30 Sep. 1966
W. Siegfried Jan. 1967 16 p
(Contracts W-7405-ENG-92; EURATOM-100-62-12 RDS; EURATOM-057-64-7 TEES(RD))
(EURAEC-1803; EUR-3344; QR-15) CFSTI: HC $3.00/MF $0.65

Analyses of isothermal time-to-rupture curves of metals, plotted at different temperatures, were used in a study of the mechanics of deformation, mechanics of separation, and of structural changes. It is postulated that time-to-rupture tests of irradiated metals may also be evaluated by this method. NSA

N67-29737# Chantiers de l'Atlantique Saint-Nazaire (France).
[ON STUDIES OF STEELS] Quarterly Report, 1 Oct.–31 Dec. 1966
[Dec. 1966] 4 p
(Contract EURATOM-054-61-12 RDF)
(EURAEC-1801; EUR-3342; QR-2.42) CFSTI: HC $3.00/MF $0.65

General research was continued on the austenitization of steels. For each steel tested there was a critical heating rate below which the austenitic superheating grain is hardly or not at all refined, which results in absence of regeneration after superheating. Curves were plotted, which make it possible to predict the structure and hardness of steel plates after normalization following slag welding. Systematic stress-relief research was begun on normalized steels and on normalized and tempered steels. NSA

N67-29748# Oak Ridge National Lab., Tenn.
HISTORY OF THE AEC SODIUM COMPONENTS DEVELOPMENT PROGRAM, VOLUME II
H. W. Savage, ed. Dec. 1966 568 p refs
(Contract W-7405-ENG-26)
(ORNL-3955, Vol. II) CFSTI: HC $3.00/MF $0.65

Committee meeting reports on shell-side heat transfer, once-through steam generator, mechanical properties of materials, carbon analysis, Na mass transfer program, sodium components test installation design review, steam generator testing, and analytical procedures for determining impurities in sodium are included. Correspondence between the AEC and the contractors is catalogued. NSA

N67-29747# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
SURFACE PROPERTIES OF MAGNETIC MATERIALS Progress Report, 1 Mar. 1966–28 Feb. 1967
Edwin J. Scheibner 28 Feb. 1967 45 p refs
(Contract AT(40-1)-2755)
(ORO-2755-17; PR-7) CFSTI: HC $3.00/MF $0.65

An apparatus for surface studies is described, which combines the advantages of low-energy electron-diffraction patterns and secondary emission measurements. The energy distributions of electrons reflected from the (100) face of copper single crystals were obtained. The effects of surface conditions on the results were determined, and a cleaning procedure was established. The peaks in the energy distribution curves are interpreted as arising from plasma resonances, interband transitions, and Auger processes. Effects of varying amounts of oxygen adsorption on the energy-loss spectrum were observed. Results of measurements of the energy distributions of slow electrons scattered from the basal plane of graphite are also presented. Work in progress on the thermodynamics of surface phase transitions is summarized briefly. The planar anisotropy and rotational hysteresis of thin films of gadolinium were studied using torque measurements. The uniaxial anisotropy constants measured were 10^4 to 10^5 erg/cc. The films showed a unidirectional rotational hysteresis. Peak loss occurred at field strengths between 0.5 and 1 kOe and losses remained significant up to 10 kOe. An appendix contains abstracts of six papers based on this work. NSA

N67-29753# Cornell Univ., Ithaca, N. Y.
VARIATION OF RESOLVED PROPORTIONAL LIMIT WITH MOSAIC ANGLE FROM 77°K TO 973°K IN ZONE REFINED TUNGSTEN
Ronald Paul Simpson Feb. 1967 118 p refs
(Contract DA-31-124-ARO(D)-228)
(AROD-4917-2; NP-16649)

W crystals were prepared and purified by electron beam zone refining. A range of mosaic block angles was obtained by controlling the temperature at the molten zone. The tensile axis of the single crystals was determined from Laue back reflection X-ray patterns, and tensile properties were then determined as a function of strain rate and temperature. The resolved proportional limit at constant strain rate of the W crystals varied over a mosaic block angle from 3 to an upper limit of 8 to 10. Both the resolved proportional limit and its range, as a function of mosaic angle, decreased with increasing temperature. Activation volumes were calculated, varying inversely with temperature for both mosaic limits. The range of resolved proportional limit with mosaic angle, at constant temperature and strain rate, is interpreted in terms of the variation of boundary energy with mosaic angle. The W crystals contained interstitial elements in excess of their solubility limit, even though their total interstitial content was below 100 ppM. The elements in solution have an increasing tendency to migrate to the mosaic boundaries with increasing temperature and mosaic angle, and consequently have an important effect on the resolved proportional limit. Author (NSA)

N67-29754 Canada. Dept. of Mines and Tech. Surveys, Ottawa. Physical Metallurgy Div.
EFFECT OF URANIUM ON THE TRANSVERSE DUCTILITY OF RESULPHURIZED CHROMIUM STAINLESS STEEL ROLLED PLATE
W. M. Crawford Jul. 1966 34 p refs
(R-179; NP-16617) Available from Dept. of Mines and Tech. Surveys, Ottawa: $0.75

Tensile ductility in the transverse and longitudinal direction was investigated for AISI types 416 and 430F steels containing S at levels of 0.15% and 0.30% and corresponding uranium contents to give U:S ratios of approximately 0, 1, 4, and 7. The usual deleterious effect of S on ductility was demonstrated in the uranium-free steels and, in particular, the poor transverse ductility due to the presence of the sulfides as stringers was noted. Uranium was observed to have a pronounced effect on the morphology of the sulfides, suggesting a change in their chemical composition. At U:S ratios in the region 4:1, globular sulfides replaced the stringers and the ratio of transverse/longitudinal ductility, as measured by per cent reduction of area, was of the order of unity. Also, in this condition, the 0.15%-S steels and the 0.30%-S steels showed similar ductilities. These beneficial effects were obtained for both grades of steel in the soft, annealed condition, and for Type 416 quenched and tempered to a higher strength. Author (NSA)

N67-29761# Nuclear Metals, Inc., West Concord, Mass.
FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. DEVELOPMENT OF A FABRICATION PROCESS FOR ZIRCALOY—ALUMINUM COMPOSITE PRESSURE TUBING Final Report, Jul. 15, 1965–Jul. 15, 1966
A. M. White 15 Jul. 1966 60 p
(Contract AT(30-1)-2784)
(NMI-2200.11) CFSTI: HC$3.00/MF$0.65

Fabrication methods were investigated for Zircaloy-4 pressure tubes lined on the inside with Al. Since bonding was required to withstand thermal cycling, the bond was determined primarily by ultrasonic testing before and after various thermal treatments. Methods involving low deformation showed little promise of success and, therefore, were not investigated extensively. Ball-sizing, i.e., extrusion of an Al sleeve by pulling an over-size plug through it so that it elongated and came in contact with the Zircaloy surrounding it, gave results which were usually good at 950°F but the quality decreased as the processing temperature was lowered. Lubrication was not satisfactory at the higher temperature but better inside surfaces were obtained as the processing temperature was decreased. Further evaluation is required, but it appeared that a zinc electroplate on the mating surface of the Al permitted bonding to occur by ball-sizing at about 650°F. Lubrication is facilitated at this temperature. There was evidence that zinc on the inner surface facilitated lubrication at 650°F. Coextrusion was investigated in a small auxiliary effort. The two metals could be coextruded but wavy surfaces were obtained. When SAP was substituted for 25 Al, good surfaces resulted. The coextruded samples were used in diffusion experiments which showed that interdiffusion between Al and Zircaloy was greater than between SAP and Al.
Author (NSA)

N67-29783# IIT Research Inst., Chicago, Ill. Technology Center.
RESEARCH ON ZIRCALOY BRAZE ALLOY DEVELOPMENT Quarterly Report, Oct. 1–Dec. 31, 1966
Deral E. Kizer and Z. P. Saperstein 17 Jan. 1967 12 p
(Contract AT(11-1)-578)
(IITRI-578P29-8; IITRI-B6084-8; EURAEC-1810) CFSTI: HC $3.00/MF$0.65

Developments in the production of a braze alloy suitable for joining Zircaloy-clad fuel elements for use in a pressurized water reactor are reported. Most of the zirconium-base binary alloys have been brazed and are being tested in autoclaves. A second series of braze alloy candidates are being prepared for similar evaluation.
Author (NSA)

N67-29807# United Kingdom Atomic Energy Authority, Risley (England). Reactor Group.
BIBLIOGRAPHY ON LIQUID METALS, 1964–1965
S. H. Fennay Nov. 1966 79 p refs *Its* TRG Inform. Ser. 312(R), Suppl. 1
CFSTI: HC$3.00/MF$0.65

A bibliography comprising of unclassified references to the literature on liquid metals, particularly sodium and sodium/potassium is presented. It is a continuation of TRG Information Series 312(R) and covers a further two years adding 649 references.
Author (NSA)

N67-29812# Comitato Nazionale per l'Energia Nucleare, Rome (Italy).
METASTABLE PHASES IN URANIUM ALLOYS WITH LOW NIOBIUM CONTENT AND THEIR THERMAL DECOMPOSITION [FASI METASTABILI IN LEGHE DI URANIO A BASSO TENORE IN NIOBIO E LORO DECOMPOSIZIONE TERMICA]
F. Coppola and C. Fizzotti 1966 37 p refs In ITALIAN
(RT/MET/66/2)

The metastable phases obtained in U alloys with 0.5 to 30 wt % Nb as a result of tempering in water at 900°C and the thermal decomposition of solid solutions at 400 to 625°C were studied. Microscopic examination of the metastable phases showed three diverse types of grains in the alloys. The alloys with 0.5% Nb showed grains more or less equiaxial with those found in unalloyed U. The alloys with 1 and 2% Nb showed, needle-shaped grains and the alloys with 2.5, 3, 4, and 5% Nb had band grains. The thermal stability of the needle-type structures and the band structures were determined by heating in the temperature region from 400 to 625°C. In the 1% alloy decomposition kinetics indicated three successive types of precipitation. The needle grains less rich in Nb were more stable. At higher concentrations the needle-type grains became less stable thermally and precipitation of the γ phase caused recrystallization in limited zones of the matrix whereas transformation of the precipitated phase completed recrystallization of the matrix. The Martensite band had similar conditions of thermal instability but in contrast to the needle-type grains the band grains recrystallized rapidly and completely in 3% alloys. A second recrystallization was also observed in these alloys.
NSA

N67-29823# Battelle Memorial Inst., Geneva (Switzerland).
RESEARCH TO DETERMINE THE LONG-TERM MECHANICAL PROPERTIES OF METALS SUBJECTED TO MECHANICAL STRESS AT ELEVATED TEMPERATURES AND NEUTRON IRRADIATION Quarterly Report, 1 Apr.–30 Jun. 1966
W. Siegfried and S. Zimering Sep. 1966 8 p
(Contracts EURATOM-100-62-12 RDS; EURATOM-057-64-7 TEES (RD))
(EURAEC-1714; EUR-2895; QR-14) CFSTI: HC$3.00/MF$0.65

A summary is given of work done in the following areas: (1) relationship between the time-to-rupture curves and the various classes of mechanism taking place during the rupture process; (2) time-to-rupture tests on pure iron; (3) application of the exponential function of real order to the extrapolation of time-to-rupture tests; and (4) application of investigation methods to time-to-rupture tests under neutron irradiation.
NSA

N67-29824# Compagnie des Ateliers et Forges de la Loire, Paris (France). Dept. des Recherches.
MECHANICAL PROPERTIES OF STEELS Quarterly Report, Jan.–Mar. 1966
[1966] 125 p
(Contract EURATOM-033-64-9 TEEF(RD))
(EURAEC-1645; EUR-2843; QR-6) CFSTI: HC$3.00/MF$0.65

Embrittlement tests with and without stress, creep tests, and stress-corrosion tests were, or are being, conducted at high temperatures on austeno-ferritic and austenitic steels. The stress-corrosion tests were made in solutions of $MgCl_2$, dilute chlorides at different pH, soda, and $FeCl_3$. The steels tested include Uranus 50, Uranus 50 Si, Uranus ST, Uranus ST Si, Uranus S, Uranus SD, ICN 472 BC, ICN 164 BC, and Krupp V II A.
NSA

N67-29825# Neratoom, N. V., The Hague (Netherlands).
STAINLESS STEEL CLADDING OF HEAVY GAGE STEELS Quarterly Report, 1 Jan.–31 Mar. 1966
[1966] 14 p Prepared Jointly with Ghent Univ. and Soudometal
(Contract EURATOM-008-63-12 IEEB(RD))
(EURAEC-1692; EUR-2879; QR-7) CFSTI: HC$3.00/MF$0.65

Welding techniques are being developed for the cladding of steel plates and shells with stainless steel tape. Welding parameters were determined for the deposition of single layers of AISI 308 ELC, and a composition-correcting flux was selected. Data on the chemical composition of the deposits are included. Results of the cladding of an inner shell surface with 304 ELC are also given.
NSA

N67-29830# Argonne National Lab., Ill.
DEPENDENCE OF THE IRRADIATION BEHAVIOR OF A HARDENABLE Ni–Cr–Fe ALLOY ON THE STATE OF PRECIPITATION [ABHAENGIGKEIT DES BESTRAHLUNGS-VERHALTENS EINER AUSHAERTBAREN Ni–Cr–Fe-LEGIER-UNG VOM AUSSCHEIDUNGSZUSTAND]
H. Boehm, W. Dienst, H. Hauck, and H. J. Laue Jan. 1967 10 p refs Transl. into ENGLISH from J. Nucl. Mater. (Amsterdam), v. 20, no. 1, 1966 p 87–93
(ANL-TRANS-421) CFSTI: HC $3.00/MF $0.65

The effects of neutron irradiation (1.4×10^{21} n/cm^2, E>100 kev) on the mechanical properties of a precipitation hardenable Ni–Cr base alloy was investigated for various initial states of precipitation. The results established that the rise in flow stress owing to irradiation is in large measure independent of the state of precipitation and that irrespective of the state of precipitation, the strain to fracture is reduced below 4%. It was also found that the work-hardening rate $(d\sigma/d\varepsilon)_{0.2}$ is reduced by irradiation, and that the tensile strength in some instances, is raised by irradiation, lowered in others. The direction of this change is not correlated in any simple way with the state of precipitation.
Author (NSA)

N67-29841# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
STATISTICAL TREATMENT OF INTERMETALLIC DIFFUSION DATA
R. F. Gloden and A. Hubaux Brussels, Apr. 1967 16 p refs
(EUR-3458.e)

A regression method is described to extrapolate experimental values through the use of a nonlinear relation of the form: $\phi(x) = f_1(t_1) \cdot f_2(t_2) \cdot f_3(t_3) \ldots$ where x is the so-called dependent variable, the t_i are independent variables which are supposed to be measured without error, and where ϕ and the functions f_i each contain one parameter. The method has been conceived to study the diffusion behavior of metallic couples, through the use of the relation $x^n = k_0\, t\, \exp(-Q/RT)$, where x stands for the thickness of the diffusion zone, t for time and T for temperature; n, k_0 and Q are parameters. First, these parameters are estimated, by iterations, from the observations; then, tests are made to search possible changes in the values of these parameters; finally, the confidence limits of the extrapolated values of x are calculated. The computations are done with the help of a Fortran IV program.
Author

N67-29852# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
CHLORIDE STRESS CORROSION CRACKING IN THREADED 300 SERIES STAINLESS STEEL COMPONENTS
S. P. Gibson, W. Evans, and R. D. Watson May 1967 16 p refs Presented at Can. Nucl. Assoc. Ann. Conf., Montreal, May 1967
(AECL-2878) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.50

Chloride stress corrosion cracking has caused costly failures of type 300 series, stainless steel, threaded components, in high temperature water systems. The source of chloride, in some instances, has been traced to chloro–fluoro organic compounds used as lubricants for assembling the threaded components.
Author

N67-29871# Aerojet-General Nucleonics, San Ramon, Calif. Nuclear Products and Services Group.
EVALUATION STUDY OF HASTELLOY X AS A NUCLEAR CLADDING Quarterly Progress Report, Oct. 1–Dec. 31, 1966
Feb. 1967 43 p
(Contract AT(04-3)-368)
(AGN-8214) CFSTI: HC $3.00/MF $0.65

The mechanical properties and oxidation of Hastelloy X were evaluated for use as nuclear cladding material. The oxidation penetration data for low and commercial tubing exposed at temperatures between 1300 and 1800°F were analyzed to determine the time and temperature dependence of this reaction. The results indicated that the limiting oxygen transport mechanism changes from diffusion through the oxide film to diffusion through the metal matrix at temperatures low in this range. Regression analyses of the penetration data were performed to determine activation energies for the oxidation reaction. Room temperature tensile testing of specimens exposed up to 7500 hr at 1900 and 2000°F was completed. All samples tested reached a ductility maximum after 100 hr exposure, followed (in samples from two heats) by a sharp decrease in ductility after 1000 hr. Tensile creep curves were typified by initially increasing creep rates that reach a maximum depending upon applied stress. Bending creep curves followed a more classical form, having a short primary creep stage followed by an extended secondary stage.
NSA

N67-29928 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
EFFECT OF COMPOSITION AND NEUTRON IRRADIANCE ON THE BRITTLENESS OF IRON AND STEEL [EFFETTO DELLA COMPOSIZIONE E DELLO IRRAGGIAMENTO NEUTRONICO SULLA FRAGILITA' DEL FERRO E DELL'ACCIAIO]
F. S. Rossi and M. Castagna 1966 27 p refs In ITALIAN Presented at the 12th Natl. Conf. of the Assoc. Ital. di Met., Bari, Italy, 5–9 Nov. 1966 Sponsored by EURATOM
(SORIN-99; M/260)

The structural steel selected for the walls of pressure vessels of nuclear reactors is considered. The radiation shielding strength of the structural material in regard to brittleness and other mechanical properties of its composition is evaluated. Results obtained from transition temperature measurements of several parameters are shown graphically.
Transl. by R.U.

N67-29929 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF COMPOSITION AND NEUTRON IRRADIANCE ON THE CORRELATION BETWEEN THE MECHANICAL PROPERTIES AND GRAIN SIZE OF IRON [L'INFLUENZA DELLA COMPOSIZIONE E DELLO IRRAGGIAMENTO NEUTRONICO SULLA CORRELAZIONE FRA PROPRIETA' MECCANICHE E DIMENSIONI DI GRANO NEL FERRO]
A. Ferro (Ist. Elettrotec. Nazl. Galileo Ferraris), M. Castagna, and F. S. Rossi 1966 28 p refs In ITALIAN Presented at the 12th Natl. Conf. of the Assoc. Ital. di Met., Bari, Italy, 5–9 Nov. 1966
(Contract EURATOM-075-65-10 TEEI)
(SORIN-100; M/261)

The grain size and quantities of carbon and nitrogen are examined in relation to the mechanical properties of iron irradiated by neutrons. For industrial application, the stoichiometry relationship between titanium concentration and the carbon and nitrogen is analyzed as a function of the deformation velocity. A mathematical expression is presented for Petch's law, and the role of interstitial atoms in high purity iron is also discussed.
Transl. by R.U.

N67-29930 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
ON DUCTILE/BRITTLE FRACTURE TRANSITION IN INTERSTITIALLY FREE IRON [SULLA TRANSIZIONE DUTTILE FRAGILE DELLA FRATTURA NEL FERRO PRIVO DI INTERSTIZIALI]
A. Ferro (Ist. Elettrotec. Nazl. Galileo Ferraris) and F. S. Rossi 1966 16 p refs In ITALIAN Presented at the 12th Natl. Conf. of the Assoc. Ital. di Met., Bari, Italy, 5–9 Nov. 1966
(Contract EURATOM-075-65-10 TEEI)
(SORIN-101; M/262)

The amount of nitrogen and carbon present in iron and steel sufficient to produce dislocation locking is considered since this effect influences fracture mechanisms due to interstitials. Preliminary results obtained from a study of fragile rupture in iron in which effects due to interstitials being considered absent are presented. Grain size, degree of iron purity, and the ductile cleavage transition are factors expressed in the mathematical calculations. Transl. by R.Ll.

N67-29933# Aeronautical Research Council (Gt. Brit.).
A SURVEY OF THE MECHANICS OF UNIAXIAL CREEP DEFORMATION OF METALS
J. W. L. Warren Jan. 1966 45 p refs
(ARC-CP-819) HMSO: 8s 6d

Time hardening, life fraction and strain hardening hypotheses variously proposed to describe uniaxial creep deformation are considered and compared with experimental evidence. It is concluded that the strain hardening hypothesis is the most nearly correct, the experimental strains usually being within 50% of those predicted. Rheological and modified strain hardening hypotheses, proposed to overcome the limitations associated with strain hardening, are surveyed. It is concluded that the latter is the most likely to be successful. Author

N67-29934 United Kingdom Atomic Energy Authority, Harwell (England). Metallurgy Div.
VIBRATORY COMPACTION OF METAL AND CERAMIC POWDERS. A BIBLIOGRAPHY
P. J. Jones, comp. Feb. 1967 8 p refs
(AERE-BIB-153) HMSO: 1s 9d

A bibliography on vibratory compaction of metal and ceramic powders is presented alphabetically by author, and an author index is included. Sources from which the titles were obtained are Nuclear Science Abstracts, British Ceramic Abstracts, C. G. Goetzler's paper on powder metallurgy, and the Planseeberichte fur Pulver Metallurgie. M.W.R.

N67-29960# General Motors Corp., Santa Barbara, Calif. Defense Research Labs.
SPALLATION THRESHOLDS OF I-400 BERYLLIUM
J. A. Charest and R. L. Warnica Jul. 1966 22 p refs
(Contract AT(29-1)-789)
(SC-CR-66-2085) CFSTI: HC $3.00/MF $0.65

Incipient spall thresholds of I-400 Be were determined. Target loadings were obtained by planar impacts of I-400 Be discs against targets of the same material. Three submicrosecond target loadings were investigated and results show this alloy to have time-dependent incipient spalls. They were observed at impact velocities of about 550, 500, and 400 feet/sec for 0.2, 0.4 and 0.8 μ sec times of loading, respectively. NSA

N67-29988*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
DEVELOPMENT AND EVALUATION OF MAGNETIC AND ELECTRICAL MATERIALS CAPABLE OF OPERATING IN THE 800° TO 1600°F TEMPERATURE RANGE Quarterly Report, 1 Mar.–31 May 1966
P. E. Kueser et al Jun. 1966 163 p refs
(Contract NAS3-6465)
(NASA-CR-54359, Rept.-66.39E; QR-6) CSCL 11F

Continuing research in magnetic and electrical materials for application to advanced space electric power systems is reported. In the development of high-temperature magnetic materials for use in solid rotors of electrical generators, details are given on progress in optimized precipitation hardened magnetic materials, dispersion-strengthened magnetic materials, and creep testing. In the investigation to determine the feasibility of high-temperature capacitors using dielectric materials, a five-layer capacitor of BN with platinum electrodes completed a 250-hr stability test with no significant change in performance. An account is given of the development of alkali-metal compatible ceramic-to-metal seals and combinations of material designed into a stator with a bore seal, a transformer, and a solenoid for investigations of compatibility under electric and magnetic stress at elevated temperature and under high vacuum. No changes were observed in the electric conductor performance after >4000 hours of testing; electric insulation performance on ac components was unaffected; and a slight decrease in resistance was observed in the energized solenoid. L.E.W.

N67-30010* Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
ALUMINUM ALLOY 5456 Materials Data Handbook
John Sessler and Volker Weiss, ed. May 1966 128 p refs
(Contract NAS8-11345)
(NASA-CR-85236) CFSTI: $3.00 CSCL 11F

Reported is a handbook which contains a comprehensive summary of materials property data on aluminum alloy 5456. The scope of information includes physical and mechanical property data at cryogenic, ambient and elevated temperatures, supplemented with useful information in such areas as material procurement, metallurgy of the alloy, corrosion, environmental effects, fabrication and joining techniques. Design data are presented, where available, and these data are complemented with information on the typical behavior of the alloy. Information on the alloy is given in the form of tables and illustrations supplemented with descriptive text. Source references for the information presented are listed at the end of each chapter. S.C.W.

N67-30088# College of Aeronautics, Cranfield (England). Dept. of Materials.
THE EFFECT OF VARYING STRAIN-RATIO ON THE HYDRAULIC BULGING BEHAVIOUR OF ALUMINIUM SHEET
Charles H. Bott and Roger Pearce Nov. 1966 25 p refs
(CoA-NOTE-MAT-9)

Annealed commercial-purity aluminum sheet was cold-rolled up to 32% and the effect of this treatment on the strain-ratio (r) in various directions in the sheet plane was evaluated. Up to approximately 16% cold reduction r_0, r_{45}, and r_{90}, remained approximately constant, while the average strain-ratio, $\bar{r}$, showed no change. At cold reductions in excess of 16% r_0 and r_{90} fall steadily, while the fall in r_{45} is less pronounced. Specimens were then electromarked with an array of 0.1 in. dia. circles and bulged, using a pvc punch technique. Plots of natural thickness strain (ϵ) vs. bulge height (h max) show that, for a given height, the strain distribution is more even for an annealed material than for a cold-worked one, due to the effect of work-hardening. The relationship between polar thickness strain and uniaxial uniform elongation (ϵ_u) shows a discontinuity at about 10% ϵ_u and a further plot of h and $\bar{r}$ against $\bar{\epsilon}_u$ suggests that this is associated with the change in strain-ratio. Thus, bulge height increases linearly with increasing uniform elongation at a constant strain-ratio, but in a more complex fashion with varying strain-ratio. Author

N67-30094 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.
INFLUENCE OF COMPOSITION ON THE BRITTLENESS OF IRRADIATED PURE IRON [INFLUENCE DE LA COMPOSITION SUR LA FRAGILITE DU FER PUR IRRADIE]
J. Sebille (EURATOM, Brussels), M. Castagna, and F. S. Rossi 1966 26 p refs In FRENCH Presented at the 10th Colloq. de Met. "Fragilite et Effets de l'Irradiation", Saclay, France, 23–24 Jun. 1966
(SORIN-96)

Studies were undertaken to examine the variations in several iron alloys before and after irradiation, and to determine the defects

introduced and the interstices present in the original material. It was observed that the threshold of the damage measured by testing the impact of a dose of 2×10^{18} is strictly dependent on the composition of the material. Resilience measurements made on irradiated specimens subjected to thermal annealing confirmed that recovery from damage depended on the composition. Transl. by M.G.J.

N67-30096 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.

ON THE EFFECT OF NITROGEN ON THE MECHANICAL PROPERTIES OF NEUTRON IRRADIATED PURE IRON

A. Ferro (Ist. Elettrotec. Nazl. G. Ferraris), J. Sebille (EURATOM, Brussels), F. S. Rossi, and M. Castagna 1966 34 p refs Presented at the Symp. on The Effects of Radiation on Structural Metals, Atlantic City, 29 Jun.–1 Jul. 1966 Sponsored by EURATOM/USAEC

(SORIN-87)

Changes in the mechanical properties of pure iron remelted in vacuum, and with the last traces of interstitials completely blocked by suitable titanium addition, were determined on specimens of different grain sizes. The material was then irradiated in a swimming pool reactor with fast neutrons. A second batch of specimens with different grain sizes was prepared from the pure remelted iron, and was then deoxidized with silicon or aluminum in which a rather large concentration of nitrogen (0.02 weight %) was introduced by addition of nitrided iron in the melt before pouring. This batch was then irradiated. Transition temperature changes, and other influences of the nitrogen presence on the mechanical properties of the batch are discussed. L.S.

N67-30097 Societa Ricerche Impianti Nucleari, Saluggia (Italy). Centro Ricerche Nucleari.

ON THE INFLUENCE OF SOME KILLING ELEMENTS ON THE MECHANICAL PROPERTIES OF NEUTRON IRRADIATED IRON

F. S. Rossi and M. Castagna 1966 22 p refs Presented at the Colloq. EURATOM sur la Rupture Fragile, Brussels, 11–13 Jan. 1966

(Contract EURATOM-004-63-TEEI (RD))

(SORIN-83)

The addition of small quantities of killing elements to the vacuum melted Armco iron was observed to produce materials with different mechanical properties and brittleness. Titanium killed iron has been shown to be a completely interstitials-free iron alloy which does not show yield point or strain aging effects. Internal friction tests and the analysis of the parameters of the Petch and Hall equation confirmed that the iron–titanium behaviour is closely similar to that of the wet-hydrogen purified iron. Author

N67-30105# Australian Aeronautical Research Committee, Melbourne. Dept. of Supply.

THE INITIATION AND INHIBITION OF CORROSION OF IRON IN NEUTRAL AQUEOUS SOLUTIONS

K. F. Lorking Sep. 1966 19 p refs

(ARL/MET-60)

It is proposed that when iron carrying its air formed oxide film is immersed in an aerated aqueous medium, the rate of solution of ferrous ions from the oxide film controls the process of film breakdown. When the solution rate of ferrous ion is slow, as in neutral benzoate, the current induced by reduction of dissolved oxygen is adequate to cause anodic passivation and prevent reductive dissolution of ferric ions in the oxide lattice. If ferrous ion solution from the film is rapid, as in neutral sulphate, the current induced by reduction of dissolved oxygen is not adequate to cause passivation before areas of oxide free iron are exposed. In some solutions, such as neutral phosphate, electrochemical action alone is not sufficient to maintain passivity. Author

N67-30111# College of Aeronautics, Cranfield (England). Dept. of Production and Industrial Administration.

DIMENSIONAL CHANGES RESULTING FROM THE HEAT TREATMENT OF EN 30B AND NIMAR 125

C. F. Noble Dec. 1966 29 p

(CoA-NOTE-M+P-15)

Three components have been manufactured in both EN 30B and NIMAR 125. Dimensional changes following heat treatment have been recorded and, while the same is only small, the report serves to illustrate the potential benefits which arise from the use of maraging steel. NIMAR 125 is shown to have reasonably predictable dimensional characteristics and thus indicates the feasibility of completing all machining operations prior to heat treatment. Author

N67-30113 Wissenschaftliche Gesellschaft fur Luft- und Raumfahrt, Cologne (West Germany).

A REPORT OF THE MEETING OF WGLR-SUBCOMMITTEE ON HEAT RESISTANT MATERIALS, 20 OCT. 1966, IN AACHEN [BERICHT UBER DIE SITZUNG DES WGLR-UNTERAUSSCHUSSES WARMFESTE WERKSTOFFE AM 20. OKTOBER 1966 IN AACHEN]

31 Jul. 1966 45 p refs

(DLR-MITT-66-11)

This report contains two papers in full and discussions of four additional papers that were presented at the conference. The two papers treat the following subjects: (1) requirements regarding materials and manufacture of gas turbine blades for aerospace propulsion systems, including loads, problems encountered with convection-cooled cast blades, and coatings for transpiration-cooled blades; and (2) metallographic and roentgenographic examination of phase precipitation in two cobalt alloys, namely X40CoCrNi4520 and X10CoCrWNi5020. The discussions of the as yet unpublished papers concern the following: (1) wear and thermal stability of some austenitic Co–Cr–Ni alloys; (2) aging and wear of some austenitic steels without cobalt; (3) effect of various protective coatings on wear and fatigue properties of the steel X2NiCoMo 18 7 5; and (4) optical examination of warping in plates due to thermal shock, using glass plates as test models. Transl. by K.W.

N67-30118# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

FABRICATION AND MECHANICAL PROPERTIES OF SINTERED ZIRCONIUM–YTTRIA DISPERSIONS

J. Rezek and B. G. Childs Jan. 1967 96 p refs

(AECL-2633) Available from Atomic Energy of Canada, Ltd., Chalk River: $2.00

Various stages in the development of a route for fabricating zirconium–yttrium oxide dispersions are described together with the improvements in stress-rupture properties resulting from each stage. The best properties were achieved with a 5 volume % dispersion of fused crushed and sized (<0.5 μm) yttria particles where the dispersion was subjected to a double cycle of fabrication with an intermediate rehydriding step. The rupture time and minimum creep rate of this material at 500°C were improved roughly tenfold over the corresponding properties for sintered zirconium. The improvement is ascribed to the stabilizing effects of the particles on the grain structure. No strength contribution from direct dislocation-particle interaction was detectable. Some subsidiary experiments on the production and properties of zirconium–yttrium oxide and zirconium–cerium sulfide alloys by arc melting and heat treatment are also described. Author

N67-30123*# Aerojet-General Corp., Sacramento, Calif.

APPLICATION OF ALLOY 718 IN M-1 ENGINE COMPONENTS

F. T. Inouye, V. Hunt, G. R. Janser, and V. Frick Washington, NASA, Jun. 1967 171 p ref

(Contract NAS3-2555)

(NASA-CR-788) CFSTI: $3.00 CSCL 11F

Large quantities of Alloy 718 were used in fabricating components for the M-1 engine, which is a 1.5-million-pound-thrust liquid hydrogen/liquid oxygen engine. The development work performed to evaluate the alloy during the design and initial production phases is reported. Establishment of heat treatment criteria and properties of Alloy 718 for applications from −425°F to 1350°F are described. Critical welding of heavy sections was performed by electron-beam welding and tungsten inert gas arc welding and are described for specific components. Author

N67-30181*# General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
CONTAMINATION EXPOSURES OF COLUMBIUM AND Cb–1Zr ALLOY SPECIMENS Final Report, 22 Jan. 1964–22 Jan. 1965
22 Jan. 1965 105 p refs
(Contract NAS3-4169)
(NASA-CR-72264; DMS-65-2) CSCL 11F

An experimental program was conducted to determine the oxidation rate of niobium and niobium–zirconium alloys under conditions of low pressures and high temperatures. A total of nine exposures of small specimens were conducted with oxygen pressures at levels ranging from about 1×10^{-7} to about 5×10^{-5} torr, and with specimen temperature levels of 980° and 1100°C. The oxidation or gettering rates were determined by the method of measuring the pressure drop across a known flow conductance, from which the oxygen gas mass flow rates (equal to the gettering rates) were computed. These gettering rates plus predictions of oxygen pressures over the specimens, were used in calculating sticking factors for oxygen on the metal surfaces. Ion gauge calibrations for oxygen and nitrogen, and analyses of pressure distribution within the system are included. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-29082# Illinois Univ., Urbana. Dept. of Mining, Metallurgy and Petroleum Engineering.
PLASTIC FLOW RATES IN NYLON INTERPRETED IN TERMS OF DISLOCATION MOTION
Biswa N. Dey 17 Apr. 1967 25 p refs
(Contract Nonr-3985(06))
(AD-650578) CFSTI: HC $3.00/MF $0.65

Observations of the propagation of plastic band-fronts in non-oriented Nylon 6-10 monofilaments were made as a function of load and temperature; and analyzed in terms of dislocation dynamics. From the shapes and the velocities of the band-fronts, dislocation velocities are estimated and found to have a stress-dependence similar to that found for non-polymeric crystalline materials. The maximum strain required to initiate flow in Nylon is about 40%, independent of the load and strain-rate, and in agreement with previous experiments of Miklowitz, and of Williams and Bender. Measurements by Williams and Bender for Nylon 66 were also analyzed. From the stress-dependence of creep incubation times reasonable values for the mean dislocation velocity in Nylon 66, and the associated activation energy, were obtained. It is tentatively concluded that the rate of breaking of hydrogen bonds limits dislocation mobility in Nylons 6-10 and 66. Author (TAB)

N67-29106# ManLabs, Inc., Cambridge, Mass.
FABRICATION OF DENSE FINE GRAINED CERAMIC MATERIALS Final Report
D. Kalish, E. V. Clougherty, and J. Ryan Watertown, Mass., AMRA Nov. 1966 77 p refs
(Contract DA-19-066-AMC-283(X))
(AMRA-CR-67-04(F); AD-650883) CFSTI: HC $3.00/MF $0.65

High pressure hot pressing was used to prepare dense, crack free billets of boron carbide, silicon carbide, titanium carbide and titanium nitride. These materials were fabricated from high purity powders without the additions of densification promoters. Fabrications were generally performed in the vicinity of 1800C at 120,000 psi for 10 minutes. Reactive high pressure hot pressing of boron carbide and elemental boron carbide was investigated with different atomic ratios of boron to carbon. Microstructures and mechanical property evaluations were obtained for selected materials prepared by this technique. The results obtained for high pressure hot pressed boron carbide and silicon carbide materials were compared with results of similar evaluation performed on conventionally fabricated samples of boron carbide and silicon carbide. Author (TAB)

N67-29147*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MATERIALS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 65–76 refs (See N67-29141 16-34)

Investigations on carbon and graphite, pure oxide ceramics, and heat shield materials are reported. Data on tensile, bending, and kinking deformation in pyrolytic and vitreous carbons are presented. Recent data on nonhomogeneous distribution of impurities of MgO produced by varied cooling rates are discussed. Density, weight, temperature, and mass loss data are tabulated for ablating materials under different combinations of heating rate, stream enthalpy, pressure, and total heating. N.E.N.

N67-29152*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
POLYMER RESEARCH
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 104–129 refs (See N67-29141 16-34)

Continuing research in polymer chemistry for propulsion is reported. Investigations are discussed in the following areas: polymer film permeability and solubility; crosslinked block copolymers; trifluoromethyl group as an F^{19} NMR probe; electronic properties of tetracyanoquinodimethane complexes; reactions of carboxyl-terminated prepolymers and poly(alkylene oxides); and foam diffusion constants. Extensive tabulated and graphed data are included. N.E.N.

N67-29386*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NON-METALLIC MATERIALS
James E. Curry *In its* Res. Achievements Rev., Vol. II 1966 p 35–48 refs (See N67-29381 16-17)

The development of a novel cryogenic multilayer insulation system with micrometeoroid protection capabilities is described. The insulation consists of alternating plastic foam spacer layers and aluminized Mylar reflective layers. Hypervelocity impact studies have demonstrated that the insulations will provide a measure of protection against micrometeoroid damage to the tank. The total adhesives research effort is summarized with reference to supporting research contracts which supplement parallel inhouse studies now underway on critical aspects of adhesive technology. As an example of the total effort, a single program on polyurethane adhesives is discussed in detail. The permeation of gases and vapors through polymeric metals and films is a subject of wide interest in the space program. Some recent theoretical developments are reviewed which indicate that purely concentration-dependent effects can now be treated by an extension of the time lag theory. In

ideal cases where time dependent effects are secondary, the nature of the concentration dependence of the diffusion coefficient can be inferred by simple time lag experiments. Author

N67-29455# Naval Ordnance Lab., White Oak, Md. Explosions Research Dept.
THERMODYNAMIC PROPERTIES OF LIQUID WATER TO ONE KILOBAR
William A. Walker 30 Jan. 1967 80 p refs
(NOLTR-66-217; AD-651105) CFSTI: HC $3.00/MF $0.65

Recent accurate experimental P-v-t data for pure liquid water, in the range 0 to 1000 bars and 0 to 150C, are combined with other data at P = 1 atmosphere and on the saturation line, to get the thermodynamic functions for liquid water throughout this range. Tables in c.g.s. units of v, E, H, S, Gibbs function, Helmholtz function, Cp, Cv, volume expansivity, isothermal compressibility, adiabatic compressibility, and Joule-Thompson coefficient are presented for 17 isotherms, with pressure increments of 20 bars. Author (TAB)

N67-29477# Bell Aerosystems Co., Buffalo, N. Y. Structural Systems Dept.
UNRESOLVED PROBLEMS IN BRITTLE MATERIAL DESIGN—CRITICAL LITERATURE REVIEW
W. H. Dukes Paris, AGARD, May 1966 28 p refs Sponsored by AGARD *Its* AGARD Advisory Rept.-2
CFSTI: HC $3.00/MF $0.65

As an initial step in a program to appropriately refine design procedures and techniques for brittle materials, a literature survey was undertaken to review the state-of-the-art and to indicate the more important unresolved problems. Emphasis is placed on design technology specifically to meet the needs of the structural designer. Areas where significant changes are required to accept brittle materials are defined as fracture theory, statistical theory, stress analysis, test methods, and design criteria. Each is discussed in detail. The bibliography is included. M.G.J.

N67-29484# Federal Fire Council, Washington, D. C.
AN ANNOTATED BIBLIOGRAPHY ON CARBON-TETRACHLORIDE AS A FIRE EXTINGUISHANT
Harry Shoub 17 Apr. 1967 9 p refs
(AD-650735) CFSTI: HC $3.00/MF $0.65

The article presents an annotated bibliography on carbon tetrachloride as a fire extinguishant. A total of 72 references are listed. TAB

N67-29555# Carborundum Co., Niagara Falls, N. Y.
ADVANCED CERAMIC SYSTEMS FOR ROCKET NOZZLE APPLICATIONS Quarterly Progress Report, 1 Nov. 1966–28 Feb. 1967
Bruno R. Miccioli 15 Mar. 1967 11 p refs
(Contract N00017-67-c-2406)
(QR-1; AD-650508) CFSTI: HC $3.00/MF $0.65

The possibilities for mating refractory carbides with Carb-I-Tex are being investigated. Composite structures, suitable for evaluation by sub-scale motor firings, are being fabricated. The carbide-graphite composite system has been applied to a pilot ejection catapult nozzle requiring both high mechanical shock and thermal shock resistance. Three nozzles have been submitted for testing. The thermal shock tests conducted by TRW, Inc. are reported. Although limited, these indicate resistance tendencies as a function of composition. Author (TAB)

N67-29627# Princeton Univ., N. J. Frick Chemical Lab.
NETWORK RELAXATION PROPERTIES OF CROSSLINKED POLY(ETHYL ACRYLATE) AND POLY(DIMETHYL SILOXANE) IN THE RUBBERY PLATEAU REGION
Leslie H. Sperling and Arthur V. Tobolsky Mar. 1967 13 p refs
(Contract Nonr-1858(07))
(RLT-98; AD-649896) CFSTI: HC $3.00/MF $0.65

The stress relaxation properties of poly(ethyl acrylate) and poly (dimethyl siloxane) were investigated under conditions where oxidative degradation was minimized. The relaxation observed is thought to result from the continued approach to equilibrium of the network chains with cooperative thermal motion. These elastomers, representing two new classes of polymer, and two new types of crosslinking, were found to behave surprisingly like natural rubber and butadiene-styrene copolymer. Author (TAB)

N67-29656# Narmco Industries, Inc., San Diego, Calif.
HIGH-TEMPERATURE FIBERS AND CORE-SHEATH FIBER DEVELOPMENT Final Report, Sep. 1965–Oct. 1966
William H. Otto and Stanley Freske Oct. 1966 39 p refs
(Contract NOw-66-0110-c)
(AD-649537) CFSTI: HC $3.00/MF $0.65

A composite ceramic-glass fiber of core-sheath configuration was formed by drawing the fiber from melts of the core and sheath materials metered through concentric orifices. The objective was to develop a continuous high-modulus (over 20 million psi) fiber produced by sheathing a high-modulus polycrystalline core material with a high-strength, high-temperature glass. Indirect heating was found to be most satisfactory on the basis of temperature control, bushing configuration, and fiber forming. Investigations of bushing materials proved that tungsten was superior to boron nitride and that high-alumina core materials which react with tungsten with time should be contained in iridium. Research on high-modulus core materials included pure alumina, alumina modified with calcium oxide and magnesium oxide, dispersions of high-modulus microcrystals and whiskers in a matrix glass, and nucleating-crystallizing glass ceramics. Most promising were pure alumina, spinel (Al_2O_3-MgO), and calcium aluminates. Tungsten dual-melt bushing fiber forming studies disclosed a problem in interaction kinetics between the molten core and sheath materials, but this can be handled by appropriate concentric orifice design. Continuous core-sheath fiber forming was accomplished at temperatures between 3600F and 4000F. With feasibility established and the required high-temperature melt containment problem solved, the task remaining is to develop the concept to achieve higher core-to-sheath volume ratios, consistent with continuous fiber formation. Author (TAB)

N67-29719# North Dakota Univ., Grand Forks. Dept. of Physics.
RADIATION DAMAGE TO SILICA STRUCTURES
Harold D. Bale 28 Feb. 1967 11 p refs
(Contract AT(11-1)-1255)
(COO-1255-4) CFSTI: HC $3.00/MF $0.65

Data on x-ray scattering from unirradiated, pile irradiated, and quenched and annealed irradiated silica glass are reported. Scattering curves and radial distribution curves from glassy brown SiO and re-evaporated material are also shown. NSA

N67-29886*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EVALUATION OF FIBROUS MATERIALS IN A CRYOGENIC STRUCTURAL ADHESIVE Technical Report, Feb.–Apr. 1966
L. M. Roseland Nov. 1966 32 p refs
(Contract NAS7-101)
(NASA-CR-85121; SM-49202) CFSTI: HC $3.00/MF $0.65
CSCL 11A

The results of a recent cryogenic structural adhesive program are presented and discussed. Twenty-three different fibrous constructions were placed in a urethane/diamine adhesive system and evaluated in T-peel and lap shear over a temperature range from −196°C (−320°F) to 82°C (180°F). One nonwoven glass construction dramatically improves the T-peel strength at all temperatures tested, improves the consistency of results, and produces a uniform thickness bond line. Author

N67-29824# Royal Aircraft Establishment, Farnborough (England).
SNATCH-TEARING OF FABRICS: A RAPID METHOD OF APPRAISAL
J. E. Swallow Jan. 1967 20 p refs
(RAE-TR-67022)

A fractionally-replicated experimental design has been applied to results for six fabrics tested by the authors' method for the snatch-tearing of fabrics. Only eight tests are required on each fabric, and the computations are greatly simplified in comparison with those for full factorial experiments. The principal factors and regression equations characterizing the length of tear are similar in the two designs. Author

N67-29941# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
EFFECT OF PRE-STRESS ON THE STRENGTH OF UNI-DIMENSIONAL LAMINATES [INFLUENCE DE LA PRECONTRAINTE SUR LA RESISTANCE DES STRATIFIES UNIDIRECTIONNELS]
Michel Hediard [1967] 40 p refs In FRENCH; ENGLISH summary
(ONERA-TN-104(1967))

Application, during resin polymerization, of pre-stresses on the uni-dimensional armature of the laminates gives a better alignment of the fibers and imposes the state of compression in the resin. In these conditions the longitudinal retraction of the resin due to polymerization is no longer a problem. The resin can follow better the deformation of the glass fibers and this gives an appreciable increase of the strength of the unidimensional laminates whose fibers can resist tension stresses as high as 275 hectobars and sometimes even greater loadings. On a single yarn impregnated, and them polymerized in pre-stressing conditions, a resistance of 340 hectobars has been obtained. The general improvement of the resistance is a function of the pre-stresses applied. Author

N67-29953# Bendix Corp., Kansas City, Mo.
EVALUATION OF FILAMENT WOUND EPOXY COMPOSITES Final Report
W. J. Bowden and D. W. Drayer Feb. 1967 60 p refs Prepared for Sandia Corp.
(Contract AT(29-1)-789)
(SCL-CR-66-154) CFSTI: HC $3.00/MF $0.65

Nondestructive measurement techniques for determination of the internal composition of filament-wound fiberglass/epoxy panels were investigated. The techniques evaluated included: microwave analysis for glass–resin content; ultrasonic detection of porosity and voids; and beta backscatter for glass content. By use of the microwave analysis technique, a correlation was established between glass content (by weight) and voltage null points. In a second test method [investigated as part of the first technique], the correlation of data was insufficient to state that dielectric constant could be used as a measure of glass content. Analysis of the second technique disclosed a correlation between ultrasonic attenuation and porosity. This correlation was found to be closely related to the uniformity of the test sample material. The best sensitivity for detecting discrete voids was found to be a collimated beam of ultrasound in a through transmission technique. Beta backscatter appeared to be a practical method for determining glass content. There were several advantages to this technique and one possible disadvantage. The advantages concerned the simplicity of test setup and the means of contacting the test samples. The disadvantage concerned inspection depth versus part density. Author (NSA)

N67-29956# California Univ., Berkeley. Lawrence Radiation Lab.
THE EXAMINATION OF POLYCRYSTALLINE MgO BY TRANSMISSION ELECTRON MICROSCOPY
Terrance G. Langdon and Joseph A. Pask Nov. 1966 17 p refs Presented at the 3d Intern. Mater. Symp. on Ceramic Microstruct., Berkeley, Calif.
(Contract W-7405-ENG-48)
(UCRL-16887; CONF-660619-7) CFSTI: HC $3.00/MF $0.65

The possibility of using transmission electron microscopy for studying deformation mechanisms in polycrystalline MgO was investigated. The results showed that electron microscopy is a useful tool for this particular study. However, it is imperative that the specimens used approximate to theoretical density, owing to the difficulty of preparing thin foils of even slightly porous material. NSA

N67-29986# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
CONTRIBUTION TO THE STUDY OF THE RHEOLOGICAL PROPERTIES OF THE NON-SATURATED STYRENE POLYESTERS CO-POLYMERS [CONTRIBUTION A L'ETUDE DES PROPRIETES RHEOLOGIQUES DES COPOLYMERES POLYESTERS INSATURES-STYROLENE. INFLUENCE DE LA TEMPERATURE ET DE LA RETICULATION]
Jean-Claude Rosso 1967 147 p refs In FRENCH; ENGLISH summary
(NT-106(1967)) CFSTI: HC $3.00/MF $0.65

The reticulated polymers chosen are succino-fumarates of di-ethylengycol copolymerized with styrene. In the linear domain the results of creep in tension are expressed in the form of an exponential infinite series accounting in particular for parabolic creep for short durations from the starting time. The heat from deformation in tension consists in two terms, one due to expansion and the other to entropy. A torsion permits to eliminate the second term which at the beginning of creep is negative for the vitrous state and positive for the rubber-like state. Birefringence in tension is a linear function of stress and strain whose coefficients have been studied as a function of temperature and of the degree of reticulation. Author

N67-30009* Boeing Co., Seattle, Wash. Saturn Booster Branch.
IRIDITING OF 60B32066 BONDS
Robert O. Koch [1967] 14 p ref
(Contract NAS8-5608)
(NASA-CR-85233; T5-6556-11) CFSTI: HC $3.00 CSCL 11A

Lap shear specimens bonded with adhesive were tested in tensile shear at −320°F at intervals of one day and thirty days after being subjected to a modified brush iridite to determine the strength loss caused by the iridite solutions. Both the one day and the thirty day results showed an approximate 12% strength degradation indicating that the iridite solutions have a relatively fast but non-continuing detremental effect on the adhesive bonds. Although loss of bond strength increased with time it did so from the effects of humidity rather than from the iridite effects. Author

N67-30014* Volt Technical Corp., Washington, D. C.
SHOCK CONTRACTION OF SiO_2 POWDERS [UDARNOYE SZHATIYE POROSHKOV SiO_2]
A. A. Deribas, N. L. Dobretsov, V. M. Kudinov, and I. I. Zyuzin 16 May 1967 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Mineralog. (USSR), v. 168, no. 3, 1967 p 665–668
(Contract NAS5-12487)
(NASA-CR-85239; ST-ES-MIN-10604) CFSTI: HC $3.00 CSCL 11B

The method of shock-contraction in a converging cylindrical wave was applied to studies of the process taking place in SiO_2 powder. Depending upon the weight of the charge, three different effects were noted in the substance during compression: (1) With charges up to 80 g hexogen of amorphous SiO_2 a certain amount of anomalous compact glass of charcoal was obtained. (2) For charges of 100 to 170 g hexogen from amorphous SiO_2 powder

and 110 g hexogen 150 g TG-50/50 from quartz powder, a white glass of standard density was obtained along with smoked glass of increased density. (3) For great charges (150 to 200 g TG-50/50), the entire initial SiO_2 powder was transformed into glass of standard density, of which a part had a porcelain-like appearance conditioned by its fine grained vesiculation. In special experiments with charges of 40, 80, and 120 g of hexogen, it was noted that the grain size increase of the initial glass decreases the amount of forming glass and increases the index of refraction. Structural x-ray analysis showed that glass formed as a result of explosion is the amorphous phase, but, by comparison with initial glass, the compact glass gives in the region of small angles a diffuse maximum. Evidence in favor of white glass formation from stipoverite rather than by power fusion is speculated as being provided by the preliminary results of experiments on shock-contraction of $MgSiO_3$ compound powders (enstatite and mixture of oxides). S.C.W.

N67-30078*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE Monthly Technical Progress Report, 10 Jan.–9 Feb. 1967
R. F. Muraca, A. A. Koch, and J. S. Whittick 15 Feb. 1967 10 p Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-85261; MTPR-32) CFSTI: HC $3.00/MF $0.65 CSCL 07C

The objective of this work was to examine and improve polymeric materials to be used in connection with JPL spacecrafts, and to prove a study of the effects of simulated spacecraft environments on selected commercial polymeric products. Determined were changes in pertinent properties of 30 polymeric samples after a decontamination treatment, a separate thermal vacuum exposure, and a decontamination treatment combined with a thermal vacuum exposure. Volatile condensable material (VCM) was defined, and macro and micro VCM techniques were established for rapid screening of polymeric samples for maximum VCM content, total weight loss, and information on the deposition and re-evaporation of VCM as a function of time. Weight loss tests were conducted on cured silicate-MoS_2–G and phenolic–MoS_2 lubricant samples; on cured samples of epoxy, polyester–phenolic, polymide, and silicone protective coatings; and on two cured epoxy sealants. The VCM pickup on optical salt flats vs. copper collectors was compared. The effect of curing cycles on the mechanical properties of the material RTV-41/T-12 was determined. Infrared absorption spectra are given for some of the samples. K.W.

N67-30079 Du Pont de Nemours (E. I.) and Co., Wilmington, Del. Freon Products Div.
FREON E SERIES FLUOROCARBONS
[1966] 15 p
(EL-8A)

A family of five liquids is described. While they differ from each other in certain physical properties, such as volatility and viscosity, they have in common a number of useful characteristics: they are inert, stable chemically and thermally, and compatible with plastics, elastomers, and coatings; they are nonflammable and essentially hazard free; they are effective heat transfer fluids for heating and cooling by convection or by evaporation methods; they have high dielectric strength and resistivity, low losses; they are colorless, clear and stable through visible and ultraviolet to 2000 Å; and they are highly purified, single component products with sharp boiling points. In addition to the characteristics listed above, the general chemical properties of these five liquids are presented. K.W.

N67-30114# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF THE INFLUENCE OF A RADIATION OF FAST CHARGED PARTICLES ON THE DIFFUSION OF SUBSTITUTIONAL IMPURITIES IN SILICON [CONTRIBUTION A L'ETUDE DE L'INFLUENCE D'UNE IRRADIATION PAR DES PARTICULES CHARGEES RAPIDES SUR LA DIFFUSION DES IMPURETES SUBSTITUTIONNELLES DANS LE SILICIUM]
Jean-Claude Pfister 1967 48 p refs In FRENCH
(NT-156) CFSTI: HC $3.00/MF $0.65

The influence of proton and electron irradiation at energies around 1 MeV on impurity diffusion in silicon was studied. An acceleration, attributed to the network failures caused by the irradiation, is exploited to shed light on the annihilation mechanism of the failures at temperatures between 800° and 1200°C. At temperatures from 1000°C, there are fewer failures because of the migration towards fixed traps. Below this temperature, if the flow ratio is increased there is the possibility of a tremendous number of flaws that will produce electrical and mechanical changes. At temperatures below 800°C, with proton irradiation, the hydrogen precipitation sometimes causes crystal rupture. At high temperatures, the mechanism proposed for flaw diffusion is one of limited diffusion by traps that probably are in the form of oxygen atoms. Transl. by M.W.R.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-28991# Stanford Univ., Calif. Computer Science Dept.
VARYING LENGTH FLOATING POINT ARITHMETIC: A NECESSARY TOOL FOR THE NUMERICAL ANALYST
Martti Tienari 17 Apr. 1967 42 p refs
(Contract Nonr-225(37))
(CS-62; AD-650620) CFSTI: HC $3.00/MF $0.65

The traditional floating point arithmetic of scientific computers is biased towards fast and easy production of numerical results without enough provision to enable the programmer to control and solve problems connected with numerical accuracy and cumulative round-off errors. The report suggests the varying length floating point arithmetic as a general purpose solution for most of these problems. Some general philosophies are outlined for applications of this feature in numerical analysis. The idea is analyzed further discussing hardware and software implementations. TAB

N67-28034*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A MODIFIED QUASILINEARIZATION CONCEPT FOR SOLVING THE NONLINEAR TWO-POINT BOUNDARY VALUE PROBLEM
Jay M. Lewallen Washington, NASA, Jun. 1967 21 p refs
(NASA-TN-D-4025) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A new quasilinearization method, referred to as the Modified Quasilinearization Method, is proposed for numerically solving the nonlinear two-point boundary value problem with an undetermined terminal time. This method is an extension to previously proposed quasilinearization methods, in that the terminal boundary may be specified by a general function of the problem variables and time, rather than just by specific values of the variables. Moreover, for variable terminal-time problems the terminal time determination is made an integral part of the iterative method itself. In addition, a scheme is formulated and successfully implemented which significantly reduces the sensitivity of the convergence characteristics of the method to the required initially assumed parameters.

Application of the proposed method to a two-dimensional, minimum-time, Earth–Mars transfer example reveals a significant reduction in computer time required for convergence, when compared to the previously proposed quasilinearization methods. Author

N67-29051# Rocketdyne, Canoga Park, Calif. Mathematics and Statistics Research Div.
RESEARCH ON SPECTRAL ANALYSIS Final Report, 15 Jun. 1964–31 Jan. 1967
N. R. Goodman and M. R. Dubman 22 Mar. 1967 10 p refs
(Contract Nonr-4557(00))
(R-6984; AD-649631) CFSTI: HC $3.00/MF $0.65

The report presents abstracts of three technical reports entitled 'Statistical Tests for Stationarity Within the Framework of Harmonizable Time Series', 'The Spectral Characterization and Comparison of Nonstationary Processes', and 'Theory of Time-Varying Spectral Estimates'. Author (TAB)

N67-29062# Boeing Co., Seattle, Wash. Mathematics Research Lab.
RELATIONSHIPS AMONG SOME NOTIONS OF BIVARIATE DEPENDENCE
J. D. Esary and F. Proschan Jan. 1967 11 p refs *Its* Math. Note No. 501
(D1-82-0597; AD-649612) CFSTI: HC $3.00/MF $0.65

A random variable T is left tail decreasing in a random variable S if P(T < or = t divides S < or = s) is non-increasing in s for all t, and right tail increasing in S if P(T > t divides S > s) is non-decreasing in s for all t. We show that either of these conditions implies that S,T are associated, i.e. Cov(f(S,T), g(S,T)) > or = 0 for all pairs of functions f,g which are non-decreasing in each argument. No two of these conditions for bivariate dependence are equivalent. Applications of these and other conditions for dependence in probability, statistics, and reliability theory are considered in Lehmann (1966) Ann. Math. Statist. and Esary, Proschan, and Walkup (1966) Boeing documents D1-82-0567, D1-82-0578. Author (TAB)

N67-29068# Electronic Systems Div., Bedford, Mass. Decision Sciences Lab.
CYBERNETIC TESTING—PROJECT 2806—TASK 280609 FOR THE PERIOD NOVEMBER 1963 THRU MAY 1965
Emir H. Shuford, Jr. Mar. 1967 34 p refs Presented at the Symp. on "Current Trends in Computer-Based Instructional Systems", Philadelphia, 6 May 1965
(ESD-TR-67-229; AD-650668) CFSTI: HC $3.00/MF $0.65

This report presents a concrete realization of an admissible probability measurement procedure utilizing a computer-driven scope and light pen. This particular technique is appropriate for all multiple-choice type of testing. Empirical results are reported from an analogous pencil-and-paper realization of the same admissible probability measurement procedure. These results indicate a marked superiority for admissible probability measurement over traditional multiple-choice testing. It is suggested that further gains can be obtained by using admissible probability measurement procedures to sequentially test the scope of knowledge of a student. TAB

N67-29087# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON SOME PROPERTIES OF GENERALIZED SOLUTIONS OF LINEAR EQUATIONS OF ELLIPTIC AND PARABOLIC TYPE
A. V. Ivanov 8 Mar. 1967 16 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 7, 1964 p 5–15
(Contract NOw-62-0604-c)
(TG-230-T518; TT-67-61536; AD-650398) CFSTI: HC $3.00/MF $0.65

Considered are weak solutions in W(1,0)sub 2 (Omega x (0,T)) (omega is a space domain) of linear parabolic equation delta u/delta t - Lu = f + div g, where L is the sum of an elliptic second-order operator in divergence form plus lower-order terms. The existence and uniqueness theory of Ladyzhenskaya and Uraltseva for weak solutions of the first mixed problem involves requiring that the lower-order terms be in certain L sub p classes. It is shown by example that some of these requirements are necessary for uniqueness. Some similar results are also given concerning elliptic problems and concerning the Holder continuity of the solutions. Author (TAB)

N67-29107# Stanford Univ., Calif. Dept. of Computer Science.
ON THE ASYMPTOTIC DIRECTIONS OF THE S-DIMENSIONAL OPTIMUM GRADIENT METHOD
George E. Forsythe 13 Apr. 1967 47 p refs
(Contract Nonr-225(37))
(CS-61; AD-650619) CFSTI: HC $3.00/MF $0.65

The optimum s-gradient method for minimizing a positive definite quadratic function f(x) on E sub n has long been known to converge for s > or = 1. For these s the author studies the directions from which the iterates x sub k approach their limit, and extends to s > 1 a theory proved by Akaike for s = 1. It is shown that f(x sub k) can never converge to its minimum value faster than linearly, except in degenerate cases where it attains the minimum in one step. Author (TAB)

N67-29115# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Lab.
PREDICTING ERROR PROBABILITIES FOR A FUNCTION OF MEASUREMENTS BEFORE THEY ARE TAKEN
Helen D. Nelson Apr. 1967 64 p refs
(Contract DAAB07-67-C-0181)
(ECOM-0181-M1091; EDL-M1091; AD-650238) CFSTI: HC $3.00/MF $0.65

Most error analysis involving measurements depends on a knowledge of the measurements. The probabilities associated with given error limits are calculated after the measurements are taken. The present analysis undertakes to predict these probabilities, before the measurements are taken, on the basis of the statistical properties of all the random variables involved. The method developed for this prediction typically requires numerical techniques for solution, and is well suited to computer use. TAB

N67-29118# Stanford Univ., Calif. Dept. of Computer Science.
TWO ALGORITHMS BASED ON SUCCESSIVE LINEAR INTERPOLATION
J. H. Wilkinson 10 Apr. 1967 28 p refs
(Contract Nonr-225(37))
(CS-60; AD-650117) CFSTI: HC $3.00/MF $0.65

The method of successive linear interpolation has a very satisfactory asymptotic rate of convergence but the behavior in the early steps may lead to divergence. The regular false has the advantage of being safe but its asymptotic behavior is unsatisfactory. Two modified algorithms are described here which overcome these weaknesses. Although neither is new, discussions of their main features do not appear to be readily available in the literature. TAB

N67-29143*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION AND ANALYSIS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 13–22 refs (See N67-29141 16-34)

Details are presented on the extension to the Fortran IV language to include encode and decode statements. The fundamentals of syntactic processors are discussed, emphasizing syntax notation and processor development. The perihelion motion of the planet Mercury is re-examined according to Newtonian theory and using revised values of planetary masses. Computer techniques for electron and ion gun design are mentioned. N.E.N.

N67-29167*# National Aeronautics and Space Administration, Washington, D. C.
ASYMPTOTIC METHODS IN THE THEORY OF LINEAR DIFFERENTIAL EQUATIONS
S. F. Feshchenko, N. I. Shkil', and L. D. Nikolenko Jun. 1967 273 p refs Transl. into ENGLISH of the book "Asimptoticheskiye metody v teorii lineynykh differentsial'nykh uravneniy" Kiev, Izd. Naukova Dumka, 1966
(NASA-TT-F-458) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The asymptotic methods of integrating a definite class of linear differential equations are presented, specifically for those in which the coefficients are functions of slowly varying time $\tau = \varepsilon t$, where ε is a small positive parameter which indicates that the coefficients of the equation vary slowly, i.e., their derivatives with respect to the independent variable t are proportional to the small parameter ε. Author

N67-29170* International Business Machines Corp., Houston, Tex. Federal Systems Div.
CONVERGENCE AND TRUNCATION ERROR STUDY IN TIME SERIES EXPANSIONS
3 Mar. 1964 23 p refs
(Contract NAS9-996)
(NASA-CR-65616; Rept.-12-01) CSCL 12A

This study determines the radius of convergence of the Taylor series expansion in time of the coordinates representing the motion of an artificial satellite along an elliptic path. An evaluation of the truncation errors of the time series is also given to $O(t^3)$ and $O(t^5)$, where t is the length of the time interval, for the case of the smallest radius of convergence. The results of the investigation are shown in graphs. From these graphs, the radius of convergence and the truncation errors may be deduced as a function of the eccentricity of the orbit, the semi-major axis and the position of the body in its path. Results for orbits around the Earth and lunar trajectories are presented separately. Author

N67-29222# Research Triangle Inst., Durham, N. C.
SOME OPTIMUM REGRESSION DESIGNS FOR DISCRIMINATING BETWEEN TWO MODELS
A. C. Nelson, Jr. 27 Jan. 1967 28 p refs
(Contract DA-31-124-ARO(D)-323)
(SU-207; TR-4; AROD-5506-5-M; AD-649931) CFSTI: HC $3.00/MF $0.65

Very often two or more mathematical models are proposed for relating the system performance to selected variables which may affect the performance. In order to obtain the correct model statistical techniques must be provided for discriminating between models and for designing an experiment which minimizes the probability of selecting the incorrect model. Because of convenience in analyses and partly because of precedence experimenters frequently select designs which require an equal number of observations at each of several equally spaced levels. However, the results of this paper indicate that for purposes of discrimination between models the best allocation of the experimental points and the numbers of observations is not the one typically used. Many of the results given herein apply to the discrimination between a hyperbolic and a linear model; however, the techniques and some of the results have general application to other model forms. Author (TAB)

N67-29232# Stanford Univ., Calif. Computer Science Dept.
ALMOST DIAGONAL MATRICES WITH MULTIPLE OR CLOSE EIGENVALUES
J. H. Wilkinson 3 Apr. 1967 21 p refs
(Contract Nonr-255(37))
(CS-59; AD-650116) CFSTI: HC $3.00/MF $0.65

If $A = D + E$ where D is the matrix of diagonal elements of A, then when A has some multiple or very close eigenvalues E has certain characteristic properties. These properties are considered both for hermitian and non-hermitian A. The properties are important in connection with several algorithms for diagonalizing matrices by similarity transformations. TAB

N67-29366# Defense Research Corp., Santa Barbara, Calif.
THEORY, METHODS AND APPLICATION OF OPTIMIZATION TECHNIQUES
E. L. Peterson *In* AGARD Orbit Optimization and Laser Appl. Oct. 1964 p 109–162 refs (See N67-29361 16-30)

Successive and polynomial optimization techniques are discussed in terms of optimal orbit control, and these techniques are applied to (1) near optimal quasilinear rendezvous control, (2) direct and indirect solution of a boundary problem, and (3) dynamic programming of a boundary problem. For rendezvous with the orbiting satellite, the orbit is assumed to be circular and the encounter coplanar; although the approach used can be extended non-coplanar encounters and non-circular orbits. Detailed mathematical models are presented for this application, as well as for the boundary problem solutions. The dynamic programming solution is carried out for several stages analytically, and it is shown that a two-stage dynamic program produces a solution meeting the boundary conditions with a minimum return only about 7% greater than the minimum return for continuous control. Three-stage and four-stage programs will produce solutions that are progressively closer to minimum control than in the case of continuous control. M.W.R.

N67-29371*# Northeastern Univ., Boston, Mass.
FUNCTIONS OF RELAXED CONTROLS
J. Warga *In* NASA. Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 7–20 refs (See N67-29370 16-30)
(Contract NAS12-112; Grant NGR-22-011-020)

A class of problems in the mathematical control theory is considered which involves solutions of certain partial differential equations, nonadditive set functions, or other functionals. The controls are functions from a given measure metric space to another metric space. The variational problem consists of determining the minimum functional subjects to certain restrictions on the controls and the parameters for a compact set in the Euclidean n-space. An existence theorem is established that achieves the restricted minimum by relaxed controls; and each of these relaxed controls can be constructively approximated by the original controls through an approximation theorem. The theorems deal with a continuity that is relative to a mode of convergence resembling the weak convergence of measures; and this continuity of functional permits the mathematical simulation of the limits of rapidly oscillating functions in a class of mappings. The relaxed controls are patterned after Young's definition of generalized curves. M.W.R.

N67-29372*# Northeast Louisiana State Coll., Monroe.
DEVELOPMENT OF MULTIVARIATE FUNCTION MODELS BY LEAST SQUARES
D. E. Dupree and R. L. Truax *In* NASA. Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory, 1967 p 21–35 refs (See N67-29370 16-30)
(Grant NGR-19-006-001)

A computational technique is evolved for deriving the least squares approximating function that yields an error less than specified. Derivation of the function satisfying a given error tolerance in the sense of least squares is detailed, and these multivariate functional models are examined for specific problems. M.W.R.

N67-29409# Columbia Univ., New York. Operations Research Group.
MEAN SQUARE INVARIANT FORECASTERS FOR SOME WEIBULL DISTRIBUTIONS

J. Tiago de Oliveira (Lisbon Univ.) and Sebastian B. Littauer 1 Mar. 1967 17 p refs
(Contract Nonr-4259(09))
(AD-650511) CFSTI: HC $3.00/MF $0.65

Given n initial observations constituting a sequence drawn from a set X1, ... , Xn, of n independent and identically distributed random variables with the Weibull distribution (known shape parameter), a mean square invariant forecaster has been found for the expected minimum (maximum) of a subsequent sequence of the next m observations. When the location parameter instead of the shape parameter is known, reduction to the Gumbel distribution is immediate and the same technique again gives an invariant forecaster. The formulae, although amenable to computation, are cumbersome. TAB

N67-29411# Columbia Univ., New York. Operations Research Group.
MAINTENANCE POLICIES AND DISCIPLINES IN MULTI-CHANNEL SYSTEMS AND MARKOVIAN MULTI-SERVICE TYPE SYSTEMS
Israel Brosh 1 Nov. 1966 189 p refs
(Contract Nonr-266(55))
(TR-34; AD-650792) CFSTI: HC $3.00/MF $0.65

Two types of maintenance systems are examined: (1) a multicrew system with 'preemptive priority' discipline; (2) a multi-service Markovian system with 'first come first served' discipline. In the first model, four operating characteristics are obtained for machines of priority type P: average number of machines in the system and in the line, and the corresponding waiting times. In the second model the policy structure is analyzed. A procedure is attained for choosing the optimal policy for controlling such a system. It is shown that optimal policies are of the connected type and that only in one case any one of the finite number of policies will yield the same value for the objective function. TAB

N67-29427*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ESTIMATING RELIABILITY OF COMPLEX SYSTEMS
Robert H. Allor 9 Jun. 1967 78 p refs
(NASA-TM-X-53592) CFSTI: HC $3.00/MF $0.65 CSCL 14D

The analysis of simple systems is discussed whereby the system reliability equation can be determined by a relatively easy application of the fundamental probability theorems. For complex systems, two methods are presented. First, a canonical expansion scheme technique is used when the system has a relatively few number of components or the component probabilities of failure are small. If the number of components in a system is rather large and the above conditions do not hold, another method is presented to obtain the complete system reliability equation which depends primarily on defining pertinent output events for the system. The reliability functions for the components that make up a system are discussed and finally, a limited discussion is provided on implementing, controlling, and testing the solution in regard to reliability. Author

N67-29503# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
ON IGNORING THE SINGULARITY IN THE NUMERICAL EVALUATION OF CAUCHY PRINCIPAL VALUE INTEGRALS
Vincent J. Monacella Feb. 1967 10 p refs
(DTMB-2356; AD-649842) CFSTI: HC $3.00/MF $0.65

A numerical method is presented whereby Cauchy principal value integrals can be approximated by essentially ignoring the singularity. Author (TAB)

N67-29812# Applied Logic Corp., Princeton, N. J.
CRT-AIDED SEMI-AUTOMATED MATHEMATICS Final Scientific Report, 1 Jun. 1963–30 Sep. 1966
James H. Bennett, William B. Easton, James R. Guard, and Larry G. Settle Jan. 1967 60 p refs
(Contract AF 19(628)-3250; ARPA Order 700)
(AFCRL-67-0167; AD-649684) CFSTI: HC $3.00/MF $0.65

The report describes the status of the fifth in a series of five experiments in semi-automated mathematics. These experiments culminated in large complex computer programs which allow a mathematician to prove mathematical theorems on a man-machine basis. SAM V, the fifth program, uses a cathode ray tube as the principal interface between the mathematician and a high speed digital computer. An elaborate language and logical capability has been implemented in SAM V. These include I/O languages for expressing mathematical statements in a form suitable for both the mathematician and the machine to recognize and handle with ease and convenience; a language for expressing and handling sorts and range of symbols; and an auto-logic algorithm and matching routine. The latter constitute the capability for handling, automatically, logic with equality. This capability is particularly useful at an intermediate state of the proof when it is desired to have the machine try and verify automatically a given portion of the proof. TAB

N67-29537 Joint Publications Research Service, Washington, D. C.
ARTICLES ON VOTING FUNCTION AND LINEAR FRACTIONAL PROGRAMMING
3 Apr. 1967 17 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 171, no. 4, 1966 p 814–819
(JPRS-40493; TT-67-31138) CFSTI: $3.00

CONTENTS:

1. VOTING FUNCTION FOR CONTINUOUS QUANTITIES V. A. Trapeznikov p 1–6 refs (See N67-29538 16-19)
2. ON THE PROBLEM OF LINEAR FRACTIONAL PROGRAMMING L. V. Kantorovich p 7–12 refs (See N67-29539 16-19)

N67-29538 Joint Publications Research Service, Washington, D. C.
VOTING FUNCTION FOR CONTINUOUS QUANTITIES
V. A. Trapeznikov *In its* Articles on Voting Function and Linear Fractional Programming 3 Apr. 1967 p 1–6 refs (See N67-29537 16-19)

Consideration is given to the voting, or majority, function in binary logic. Both the conjunctive normal form and the disjunctive normal form are given. The possibility of defining a certain voting function for continuous signals to serve as a basis for the creation of restoring organs for analog systems with parallel redundancy is examined. The connection between logical operations on binary and continuous quantities are used for finding this function. The adduced theorem and its corollary show that the restoring organ, which fulfills a voting function, can assure the normal operations of analog systems with parallel redundancy even in case of failure of most parallel channels. L.E.W.

N67-29539 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF LINEAR FRACTIONAL PROGRAMMING
L. V. Kantorovich *In its* Articles on Voting Function and Linear Fractional Programming 3 Apr. 1967 p 7–12 refs (See N67-29537 16-19)

The problem of nonlinear programming with a linear fractional function is considered. Several methods of solution are discussed, and the optimization of an enterprise's work fund is given as an example. The maximization of the linear fractional function is examined in relation to the constraints of sales volume, products list, profits and profit rate, productive capital, wages, materials, and capacity. L.E.W.

N67-29589# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

SOME TOTAL INVARIANTS OF ASYMPTOTICALLY FLAT SPACE-TIMES

J. Winicour [1967] 29 p refs

(AD-651096) CFSTI: HC$3.00/MF$0.65

The total energy, moments, supermoments, and angular momenta of asymptotically flat space-times are calculated in terms of coordinate and conformally invariant expressions by taking the limit in an invariant way of the asymptotic symmetry linkages through a sequence of finite closed two-spaces which converge to a sphere at null infinity. The resulting expressions consist of integrals over the sphere at null infinity of coordinate and conformally invariant quantities. In the case of energy and momentum these integrals may be reduced to expressions previously proposed by Penrose. Author (TAB)

N67-29611# Carnegie Inst. of Tech., Pittsburgh, Pa. Management Sciences Research Group.

SEARCH-REDUCTION TESTS FOR A COMBINATORIAL PRODUCTION SEQUENCING ALGORITHM

Fred Glover (Calif. Univ.) Dec. 1966 18 p refs

(Contract Nonr-760(24))

(Rept.-98; AD-649937) CFSTI: HC$3.00/MF$0.65

Recently a number of tree search algorithms have been proposed for solving combinatorial optimization problems. The practical value of such approaches depends heavily on the tests used to identify and exclude dominated alternatives from consideration. An interesting study by Pierce and Hatfield gives a useful tree search algorithm for a certain class of production sequencing problems, and further motivates the search for new theoretical results on which more effective tests can be based. The paper attempts to provide such results and to lay a foundation for exploiting them in an efficient way. Author (TAB)

N67-29619# Stanford Univ., Calif. Computer Science Dept.

GRAEFFE'S METHOD FOR EIGENVALUES

G. Polya 24 Apr. 1967 13 p refs

(Contract Nonr-225(37))

(CS-63; AD-650627) CFSTI: HC$3.00/MF$0.65

Let an entire function F(z) of finite genus have infinitely many zeros which are all positive, and take real values for real z. Then it is shown how to give two-sided bounds for all the zeros of F in terms of the coefficients of the power series of F, and of coefficients obtained by Graeffes algorithm applied to F. A simple numerical illustration is given for a Bessel function. TAB

N67-29635# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematical Research Lab.

ELLIPTIC FUNCTIONS FOR COMPLEX ARGUMENTS

Henry E. Fettis and James C. Caslin Jan. 1967 412 p refs

(ARL-67-0001; AD-650477) CFSTI: HC$3.00/MF$0.65

The Jacobian elliptic functions sn(w) cn(w) dn(w) are tabulated to five decimals in the complex w = u + iv plane as functions of the nome q = .005(.005).4 for u/K = 0(.1)1. and v/K' = 0(.1)1, where q = e to the minus (pi K'/K) power and K and K' are complete elliptic integrals with moduli k and k' = square root of (1-sq. k), respectively. TAB

N67-29639# Illinois Univ., Urbana. Coordinated Science Lab.

BINARY SEQUENCE CONVOLUTIONAL MAPPING: THE CHANNEL CAPACITY OF A NON-FEEDBACK DECODING SCHEME

Franco P. Preparata Mar. 1967 38 p refs

(Contract DA-28-043-AMC-00073(E))

(R-345; AD-649665) CFSTI: HC$3.00/MF$0.65

In the paper, invertible convolutional transformations of binary sequences are examined from the point of view of performance, when the inverse transformation (decoding) is performed by a finite feed-forward transducer, which represents an approximation to the perfect feedback transducer. While this eliminates the error propagation effect, it introduces a restriction on the acceptable input sequences. The encoder-decoder system, i.e. the cascade of the direct and the inverse transducers, appears as an input-restricted noiseless channel, and a measure of performance is given by the resulting channel capacity. It is shown that as the number r of decoder stages increases, the channel capacity has an expression C congruent to 1-Ab to the r power where the parameters b<1 and A depend solely upon the structure of the set of resynchronizing states (RS-cluster) possessed by the given transformation. Author (TAB)

N67-29660# Wisconisn Univ., Madison. Dept. of Statistics.

SEQUENTIAL DESIGNS FOR SPHERICAL WEIGHT FUNCTIONS

Norman R. Draper and Willard E. Lawrence Nov. 1966 29 p refs

(Contract Nonr-1202(00))

(TR-97; AD-650275) CFSTI: HC$3.00/MF$0.65

Two papers by Box and Draper (1959, 1963) discussed the selection of first and second order rotatable designs when a spherical region of interest was defined and account had to be taken of possible biases due to the fact that the polynomial model under consideration was inadequate by one order. Here we consider a different but related problem. Suppose the intensity of interest in the factor space is represented, not by a spherical region of interest, but by a symmetric multivariate distribution weight function. (Previously it was assumed that total interest lay uniformly over a spherical region and there was no interest outside it.) We wish to specify the runs of a second order design which can be performed sequentially so that both the first order portion and the full second order design provide protection against biases of one order higher. In particular, we shall consider designs which are either the basic central composite type and consist of a cube plus star plus center points, or designs which contain an extra star. The extra star is required in some cases to allow certain conditions to be met. Author (TAB)

N67-29700# Maryland Univ., College Park, Md. Inst. for Fluid Dynamics and Applied Mathematics.

DISCRETIZATION ERROR IN THE CLASSICAL DIRICHLET PROBLEM FOR LAPLACE'S EQUATION BY FINITE DIFFERENCE METHODS

J. H. Bramble and B. E. Hubbard Jan. 1967 57 p refs

(Contract AT(40-1)-3443)

(ORO-3443-3; BN-484) CFSTI: HC$3.00/MF$0.65

The classical Dirichlet problem for Laplace's equation in a bounded subdomain R of E_n is treated by finite difference methods. Error estimates are obtained which are consistent with other results by proving the following theorem: if ∂R is C^2 and $u \epsilon H(p, A_p, \lambda)$ then max $|u(\chi) - u(\chi, h)| \leq K(\epsilon)[h^{p+\lambda-\epsilon} + h^2]$, $p = 0, 1, 2 \ldots$ where K depends only on geometric quantities, as well as A_p, λ, and $\epsilon > 0$. The result asserts that if u satisfies a Hölder condition for any exponent $\lambda > 0$, no matter how small, then by choosing $\epsilon < \lambda$ the rate of convergence $h^{\lambda-\epsilon}$ is obtained. Various generalizations of this theorem are given, which include the corresponding result for higher order approximations and, in E_2, the case where ∂R is composed of C^2 arcs with no re-entrant cusps. NSA

N67-29767# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.

WHEN DOES THE DYNAMICAL SYSTEM TURN INTO THE STATISTICAL ONE?

B. V. Chirikov 1966 13 p refs Presented at the Intern. Congr. of Mathematicians, Moscow, 1966
(NP-16532)

Some results of the analytical and numerical investigations concerning the appearance of stochasticity in a conservative system of the type of weakly coupled nonlinear oscillators are presented. The term stochasticity denotes all the statistical properties of the dynamical system. At present one is still unable to understand completely the nature of statistical laws and, hence, the conditions of their appearance. Nevertheless, there is apparently no doubt now as to which type of the mechanical motion is the basis for the appearance of the real stochasticity or, at least, of its very similar imitation. That is the mixing motion with positive Kolmogorov entropy. So when the word stochasticity is used, just this type of the motion is meant. The main problem to be solved is the obtaining of stochasticity criterion, e.g., finding out the conditions under which the statistical laws start to act in a dynamical system. From the standpoint of applications, the stochasticity is the most dangerous instability of nonlinear oscillations. Author (NSA)

N67-29767# Army Medical Research Lab., Fort Knox, Ky. Experimental Psychology Div.
INFORMATION AS A CRITERION OF GOODNESS OF FIT: EXACT CRITICAL VALUES FOR THE CASE OF EQUIPROBABLE ALTERNATIVES
James N. Cronholm 19 Apr. 1967 21 p refs
(Rept.-689; AD-650324) CFSTI: HC $3.00/MF $0.65

A table of exact critical values of the information measure H is presented for the case of n observations in k equiprobable categories ($2 < or = n < or = 15$, $2 < or = k < or = 15$). H is equivalent to the log likelihood-ratio criterion of goodness of fit. The significance levels given are: $a < or = .200, .100, .060, .025, .010, .005, .001$. Exact significance levels are presented for $a < or = .050$, and it is shown that the true significance levels of usual test (based on the chi square approximation to the distribution of the log likelihood-ratio) at the nominal .050 level exceed this value in 55 percent of the cases examined. Author (TAB)

N67-29777# RAND Corp., Santa Monica, Calif.
MATHEMATICS AT THE RAND CORPORATION
T. A. Brown Mar. 1967 31 p refs Presented at the Occidental Math. Field Day, 18 Feb. 1967
(P-3543; AD-650131) CFSTI: HC $3.00/MF $0.65

Four categories of mathematical work are discussed: linear programming, dynamic programming, flows in networks, and game theory. TAB

N67-29907# California Univ., Berkeley. Operations Research Center.
ON THE KUHN–TUCKER THEOREM
Jean Abadie Feb. 1968 27 p refs Revised
(Contracts Nonr-222(83); DA-31-124-ARO(D)-331; Grant NSF GP-4593)
(ORC-65-18; AD-630119) CFSTI: HC $3.00/MF $0.65

The general programming problem considered has the form: minimize $f(x)$ subject to $g_i(x) = o$, $i = 1,2,\ldots, m$. The regularity condition of Cottle is first generalized so that any linear system satisfies a (new) regularity condition. It is then proven that this regularity condition is actually a sufficient criterion for a certain weakened form of the Kuhn–Tucker constraint qualification property. Finally, a further generalization of the latter property is given. Author (TAB)

N67-29908# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
EXPONENTIAL LIFE TEST PROCEDURES WHEN THE DISTRIBUTION HAS MONOTONE FAILURE RATE
Richard E. Barlow and Frank Proschan Jun. 1966 31 p refs Revised /its Math. Note No. 468
(D1-82-0415; AD-636125) CFSTI: HC $3.00/MF $0.65

A number of estimates and tests for mean life and other parameters derived under the exponential distribution assumption are studied under the alternative condition that the distribution has increasing (decreasing) failure rate. The estimates considered are, for the most part, based on censored and truncated samples. It is shown that these estimated generally favor the producer (consumer) in the IRF (DFR) case. Properties of order statistics and their spacings from distributions with increasing (decreasing) failure rate are presented. Author

N67-29913*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
AN INVARIANCE PRINCIPLE IN THE THEORY OF STABILITY
J. P. La Salle Apr. 1966 21 p refs
(Contract NAS8-11264; Grant NGR-40-002-015; Contract DA-31-124-ARO(D)-270; Grant AF-AFOSR-693-65)
(NASA-CR-74165) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A unified presentation of Liapunov's theory of stability is offered, which includes the classical Liapunov theorems on stability and instability as well as their more recent extensions. Some basic results for ordinary differential equations are given, and a fundamental stability theorem for nonautonomous systems is stated. A simple example is included to show that the conclusion of this theorem is the best possible. It is pointed out, however, that when the limit sets of solutions are known to have an invariance property sharper results can be obtained. Consideration is also given to theorems which made it possible to estimate regions of attraction (regions of asymptotic stability) for nonautonomous systems, and results of this type are presented. These results are extended to autonomous functional differential equations. M.G.J.

N67-30006* Massachusetts Inst. of Tech., Cambridge. Continuum Electromechanics Group.
STABILITY OF SPATIALLY AND TEMPORALLY SAMPLED DISTRIBUTED PARAMETER FEEDBACK SYSTEMS
Robert H. Thomas [1966] 32 p refs
(Grant NsG-368)
(NASA-CR-85237; CSR-TR-67-2) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Feedback for the control of distributed parameter systems that incorporate spatial and temporal sampling is studied. A method that uses a model approach is developed for the stability analysis of such systems. To illustrate application of this method, the stability of a simple distributed parameter electromechanical system is examined. The electromechanical system analyzed is one that has been used to model electric field control of Rayleigh–Taylor instability at fluid–fluid interfaces. Author

N67-30017 Joint Publications Research Service, Washington, D. C.
REGULATION OF PROBLEMS IN STATISTICAL DYNAMICS OF AUTOMATIC CONTROL SYSTEMS
V. V. Solodovnikov et al 19 May 1967 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 172, no. 6, 1967 p 1293–1295
(JPRS-41079; TT-67-31720) CFSTI: $3.00

Methods for regulating problems encountered during the numerical solution of problems in the theory of optimal automatic control systems are described. It is shown that the applicability of the proposed methods of regulation not only give stable algorithms, but also decrease the complexity of the physical realization of the optimal systems found. S.C.W.

N67-30042* Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
ON THE DESIGN OF SPECIFIC OPTIMAL CONTROLLERS
V. B. Hess and S. Murtuza May 1967 83 p refs
(Grant NGR-15-005-021)
(NASA-CR-85266; TR-EE67-3) CSCL 12A

The design of linear constant coefficient specific optimal controllers for linear multivariable time-variant systems with inaccessible states is presented. The design procedure developed by amalgamation of conventional design practice and optimal control theory involves two distinct phases. One consists of the determination of a quadratic performance index which incorporates the performance specification for the system, and the solution of the corresponding optimal control problem. Phase two calls for the selection of a practically feasible controller configuration and the determination of its parameters such that the system performance with the specific controller is as close as possible to the performance with the optimal controller. Of major significance is the maximization procedure based on the theory of quadratic forms which yields the global maximum. The computational methods developed are applied to several examples to test the theory and to demonstrate the improvement in the result when compared to other methods. S.P.

N67-30048# Aeronautical Research Council (Gt. Brit.)
RENEWAL PROCESSES ARISING IN THE STUDY OF MULTIPLEX SYSTEMS
Z. A. Lomnicki 1967 30 p refs
(ARC-R&M-3444) HMSO: 10s 6d

Discussions are presented on the improvement of reliability of systems when redundancy is introduced in the form of so-called 'multiplexing' so that a given task is performed not by one suitably chosen set of components (referred to as a lane) but by a number of separate lanes operating independently in parallel. Under the assumption that the failure of individual lanes can be described by a Poissonian process it is shown that the renewal process representing the failure mechanism of a system composed of m lanes exhibits, for comparatively small time intervals, a dramatic improvement of reliability (from a small probability p for one lane to a much smaller probability p^m for the system), while for the large time intervals the improvement is less than proportional to m. Thus the multiplexing appears to achieve its maximum advantage only when, after a comparatively short period of operation, all the lanes are inspected and brought to their initial state by repair or replacement; without these precautions multiplexing is still useful but the law of diminishing returns operates then: by increasing the number of lanes, less and less is added to the asymptotic reliability of the system. The discussion of the general case of m lanes is followed by a more detailed analysis of duplex and triplex systems and, in the closing section, a modified method of multiplexing (the majority vote) is described. Author

N67-30049 Lockheed Missiles and Space Co., Sunnyvale, Calif.
SOME APPLICATIONS OF GAME METHODS TO OPTIMIZATION OF DESIGN SOLUTIONS
A. A. Sarkisov [1967] 5 p Transl. into ENGLISH from Izv. VUZ. Mashinostro., No. 2, 1967 p 44–48

The possibilities, in principle, of utilizing a game method to solve some technical problems are examined. It is proposed to take the class of "games with nature" as the basis of optimization of the solution, and the minimax criterion as the measure of optimization. Author

N67-30064* Pennsylvania State Univ., University Park.
DIFFERENTIAL-BOUNDARY EQUATIONS AND ASSOCIATED BOUNDARY VALUE PROBLEMS
Allan M. Krall [1967] 8 p refs
(Grant NGR-39-009-041)
(NASA-CR-85248) CSCL 12A

An attempt was made to reduce a differential-boundary system to an ordinary differential system with end point boundary conditions, and to show how to eliminate some the parameters that must be introduced in some representations. Consideration is first given to the removal of interface conditions, which are boundary conditions applied at points interior to the interval under discussion, and it is proved that differential-boundary systems and their adjoints involving interior point conditions can be reduced to such a system involving only end point conditions. Removal of the parameter ϕ is then examined as well as reduction to end point boundary conditions. It is concluded that differential-boundary systems and their adjoints can be reduced to ordinary differential systems with end point boundary conditions. I.E.W.

N67-30074*# Brown Univ., Providence, R. I. Center for Dynamical Systems.
ON THE STABILITY OF PROCESSES DEFINED BY STOCHASTIC DIFFERENCE-DIFFERENTIAL EQUATIONS
H. J. Kushner Apr. 1967 38 p refs
(Grants NGR-40-002-015; AF-AFOSR-693-67; NSF GK-967)
(NASA-CR-85258; TR-67-4) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Results from a previous study on the stability of strong Markov processes with values in a finite dimensional space are extended to processes defined by difference-differential Itô equations. The extension is analogous to the extension of the Liapunov stability theorems to theorems on the stability of the solutions of ordinary difference-differential equations of the Hall type. Interest is concentrated on criteria, of the stochastic Liapunov function type, which assure that the solution paths of the derived equation have certain stability properties. In addition to asymptotic results and the intrinsic interest in the problem attacked, an important motivation for this study is to provide a foundation for the stabilization and control of processes, defined by stochastic differential (Itô) equations, with controls depending on delayed arguments. Some useful estimates are derived concerning the probabilistic behavior of the equation solution. These are used subsequently to establish stochastic continuity, and the strong Markov character of the process. R.L.I.

N67-30083# National Aerospace Lab., Tokyo (Japan).
ON THE EXISTENCE OF DISCONTINUOUS SOLUTIONS OF THE CAUCHY PROBLEM FOR QUASI-LINEAR FIRST-ORDER EQUATIONS
Kiyofumi Kojima Oct. 1966 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-119; UDC-517.944) CFSTI: HC $3.00/MF $0.65

The existence of weak solutions of a Cauchy problem for nonlinear partial differential equations is investigated, and a previous work with a bounded measurable initial function having locally bounded variation in the sense of Tonelli–Cesari is extended. N.E.N.

N67-30125*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ON THE TRANSFORMATION TO PHASE-VARIABLE CANONICAL FORM
Robert W. Gunderson and O. R. Ainsworth (Ala. Univ.) Washington, NASA, Jul. 1967 13 p refs
(NASA-TN-D-3872) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Consideration is given to the control system defined by $dx/dt = Ax + u(t)f$, where $x = (x_1, \ldots, x_n)$ denotes an n-dimensional state vector, A is an nxn constant matrix, $f = (f_1, \ldots, f_n)$ a constant vector, and u(t) a scalar control function. If it is assumed that (A,f) is controllable, then there is known to exist a nonsingular linear transformation $x = Ky$ which reduces the above equation to a phase variable canonical form. An explicit expression for K was obtained by Johnson and Wonham in terms of the Vandermonde matrix and a modal matrix of A. To obtain this result, it is

necessary to require that the eigenvalues of A be distinct. An equally convenient expression for K is given with no restrictions placed on A, other than the controllability of (A,f) and which includes the result of Johnson and Wonham as a special case. The difference between the present result and that of Mufti is a computational one. However, the result depends on the existence of the inverse of certain transformation matrices. The present result shows that their existence is an implication of the controllability assumption. R.N.A.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-29080# Weather Squadron (20th), San Francisco, Calif. 96525
TYPHOON WEATHER MODELS KADENA AB, OKINAWA Final Report
Gary D. Atkinson and Hiram E. Penland Apr. 1967 24 p *Its* Tech. Study No. 12
(AD-650258) CFSTI: HC $3.00/MF $0.65

Synoptic models are developed to relate the maximum surface wind gusts, lowest flying weather conditions, and six-hour rainfall amounts at Kadena AB, Okinawa to the positions and intensities of typhoons. Both the mean and 90% highest values are given for the wind speeds and rainfall amounts. Independent testing indicates that these models can be used to prepare realistic and consistent terminal forecasts of typhoon produced weather at Kadena. TAB

N67-29088# Navy Electronics Lab., San Diego, Calif.
AUTOMATIC PICTURE TRANSMISSION (APT) READ-OUT STATIONS FOR SHIPBOARD RESEARCH AND DEVELOPMENT REPORT, JUL. 1963–AUG. 1966
D. R. Leonard 3 Feb. 1967 22 p refs
(NEL-1435; AD-650140) CFSTI: HC $3.00/MF $0.65

Two partially militarized stations were built, installed aboard two aircraft carriers, and tested in the western Pacific. They were found to be of significant operational value in furnishing an ability to locate major weather systems and determine the extent of cloud cover over areas from which conventional data were not available. Author (TAB)

N67-29116# Weather Wing (1st), San Francisco, Calif. 96525 Scientific Services.
THUNDERSTORMS IN SOUTHEAST ASIA
Gary D. Atkinson Mar. 1967 60 p refs
(TS-11; AD-650257) CFSTI: HC $3.00/MF $0.65

The study presents a comprehensive survey of thunderstorms in Southeast Asia (Republic of Vietnam, Cambodia, Thailand, Laos and North Vietnam). Various Southeast Asian data sources are used, and the reliability of these sources as well as the difficulties involved in obtaining reliable thunderstorm data are discussed. The monthly and annual frequencies of thunderstorm days for 83 stations in Southeast Asia are given in both table and isoline-map forms. Year to year variations in the numbers of thunderstorms observed monthly and annually are discussed. The duration and diurnal variation of thunderstorms are also considered. A thunderstorm persistency model was developed from ten years of daily thunderstorm records for selected Thailand stations. The report shows how the local thunderstorm climatology can be approximated for a Southeast Asian location where no data are available. Author (TAB)

N67-29139# Army Natick Labs., Mass. Earth Sciences Div.
LITTLE AMERICA V MICROMETEOROLOGY PROGRAM DATA AND ANALYSIS
Heinz H. Lettau (Wis. Univ., Madison), Sarah H. Wollaston, and Paul C. Dalrymple Jan. 1967 241 p refs
(TR-67-46-ES; ES-29; AD-650188) CFSTI: HC $3.00/MF $0.65

At Little America V the temperature range of each of the 9 coldest months is large, as is the annual range. Minima are controlled by advection of cold air from the interior and maxima by advection of warmer air from the Ross Sea area. The winter lacks a distinct temperature minimum, and mid-winter reversals of temperature trend occur. Micrometeorological wind and temperature profiles in the lowest 8 m of the atmosphere were recorded at Little America V in 1957, and hourly means of temperature for about 3,000 hours and wind speed for about 500 hours are published as Appendix B of this report. Procedures used to analyze the 1958 micrometeorological data from the South Pole Station are followed in this analysis and results compared with the less complex relationships at the South Pole. Author (TAB)

N67-29357*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A SYNOPTIC WORLD WEATHER ANALYSIS OF TIROS VII RADIATION DATA
Lewis J. Allison and Guenter Warnecke (Freie Univ.) Washington, NASA, Jun. 1967 45 p refs
(NASA-TN-D-3787) CFSTI: HC $3.00/MF $0.65 CSCL 04B

A synoptic world weather analysis of TIROS VII radiation data was made for January 21 and 22, 1964. The distribution of quasi-global cloudiness inferred from the channel 2(8–12μ) "atmospheric window" data was compared with a previously published study of TIROS III 8–12μ radiation data for July 16, 1961. The January 1964 radiation-synoptic analysis is characterized by a small difference in outgoing radiation between the winter and summer hemispheres, and mid-latitude frontal systems extend into the subtropics during the Southern Hemisphere summer. The January–July radiation study tends to confirm the premise that the 8–12μ infrared region is suited for global synoptic detection and tracking of meso-scale meteorological features. Author

N67-29410# Environmental Science Services Administration, Silver Spring, Md. Environmental Data Service.
AN ANNOTATED BIBLIOGRAPHY OF METEOROLOGICAL TOWER AND MAST STUDIES
J. Allen Wallace, Jr., comp. Jan. 1967 113 p refs Sponsored by Army
(WB/BS-5; AD-650781) CFSTI: HC $3.00/MF $0.65

The bibliography consists of sources containing meteorological data and information obtained from towers and mast. Primary interest is on wind data. All available sources in the U.S. Department of Commerce, Atmospheric Sciences Library, Environmental Sciences Services Administration, were examined and abstracted. Author (TAB)

N67-29441# Miami Univ., Fla. Radar Meteorological Lab.
MESOSCALE STUDIES OF INSTABILITY PATTERNS AND WINDS IN THE TROPICS Semiannual Report 1 Jun.–31 Dec. 1966
Harold P. Gerrish Mar. 1967 41 p refs
(Contract DA-28-043-AMC-00443(E))
(ML-67088; ECOM-00443-13; AD-649826) CFSTI: HC $3.00/MF $0.65

The report summarizes additional work on the extremely heavy South Florida rainstorm that produced more than twenty-one inches of rain in twelve hours on 14 October 1965. Although a tremendous amount of moisture converged into the area at 850

mb with relatively large vertical motions and attending divergence aloft, repeated attention was also drawn to that part of the atmosphere near the melting level. Moisture analysis revealed that the transport of water vapor in the 700-500 mb layer was important for the timing and perhaps severity of the event. A moist tongue at this level could be tracked into the area from the western Caribbean. A radar analysis of the storm was made using both non-contoured and contoured radar data. It was observed that enhanced analysis and forecast capability resulted from the use of contoured video. Without it, small-scale organization and location of the heaviest rain would never have been realized. Frequency distributions of video contoured by 26 db attenuation correlated extremely well with the isohyetal analysis. A quantized warning system was suggested to assist the forecaster in heavy rainfall situations. An evening radar angel pattern was found to be useful in character-typing the atmosphere. It was observed that rainfall the next day was inversely proportional to radius of the pattern. When this particular pattern formed, lines of weather moving toward Miami would tend to break up there. A synopsis of South Florida angels observed from a review of 7000 ft of radar film is presented and illustrated. TAB

N67-29488# Air Force Systems Command, Bedford, Mass. Decision Sciences Lab.

TEST CORRELATES OF AIR FORCE WEATHER FORECASTER PROFICIENCY

Alan M. Kershner Mar. 1967 28 p

(ESD-TR-67-226; AD-649678) CFSTI: HC $3.00/MF $0.65

Results are presented from the administration of a battery of twenty-two tests to 76 Air Force weather forecasters who constituted criterion groups of 'good' and 'poor' forecasters selected by the use of the nominating technique. Five potential predictors were identified. Author (TAB)

N67-29620# Electromagnetic Research Corp., College Park, Md.

METEOROLOGICAL MEASUREMENT SYSTEM Final Report

Martin Katzin, William P. Markey, James H. Meyer, Jr., David L. Ringwalt, and Thomas S. Weaver Griffiss AFB, N. Y., RADC, Mar. 1967 181 p refs

(Contract AF 30(602)-4233)

(RADC-TR-67-58; AD-650790) CFSTI: HC $3.00/MF $0.65

The report presents the results of a design study of a Meteorological Measurement System for use in studying the correlation of the lower atmospheres meteorological constituents with the propagation of electromagnetic energy. Techniques employed in the measurement of the pertinent meteorological parameters are discussed and the types of available sensors having accuracies and response times meeting the requirements of the program are described. The problem of comparing an integrated measurement of refractivity with point measurements of the meteorological parameters at intervals along the path is described, and a method is given for determining the number of point measurements required to achieve a desired accuracy. Recommendations are given for two independent measurement configurations, one for use in the Improved Sampling Techniques Program, the other for use in the Optical Propagation Program. A detailed logic design is given of the data storage and monitoring system which is capable of accepting data from a large number of sensors at a controllable sampling rate. Author (TAB)

N67-29805# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.

A PRELIMINARY REPORT ON DOPPLER RADAR OBSERVATION OF TURBULENCE IN A THUNDERSTORM

Ralph J. Donaldson, Jr. Jan. 1967 24 p refs *Its* Environ. Res. Papers, No. 255

(AFCRL-67-0015; AD-649779) CFSTI: HC $3.00/MF $0.65

Vertical-incidence observations by Doppler radar of velocities in a thunderstorm reveal some regions in which the spread of velocities is unusually broad. The widths of the vertical velocity spectra are generally greatest along the edges of a major updraft, where the maximum shear in updraft speed also occurs. The observations indicate that turbulence is an important cause of the abnormally wide velocity spectra, and suggest the utility of Doppler radar measurements of the vertical velocity spectrum as an indicator of severe cloudy-air turbulence. Furthermore, vertical velocity spectra in the more convective regions of thunderstorms, where they may be seriously affected by turbulence and wind shear, probably give an exaggerated picture of the particle size distribution. TAB

N67-29671# Stanford Research Inst., Menlo Park, Calif.

THE RELATIONSHIP BETWEEN MARITIME PRECIPITATION RADAR ECHOES AND CLOUD COVER VIEWED BY SATELLITES IN POLAR ORBITS Final Report, Jan. 1965–Dec. 1966

Roy H. Blackmer, Jr. and Sidney M. Serebreny Jan. 1967 87 p refs

(Contracts N62306-1642; Cwb-11091)

(AD-649003) CFSTI: HC $3.00/MF $0.65

Analysis of concurrent radar data and TIROS IX cloud photographs were made to develop techniques for determining areas of precipitation and severe weather within a given satellite observed cloud situation. During the four-month period studied (14 February to 15 June 1965) there were a number of occasions when frontal bands or cyclone centers were within range of one or more of the ten radar sites at the time of satellite passage. Examples of the precipitation distribution associated with various synoptic patterns are presented with discussions of pertinent features of the attendant cloud cover. From these examples a model of the probable distribution of precipitation within and around a typical maritime cyclone was constructed. The report also discusses situations in which there is widespread cloud cover but little or no precipitation. Author (TAB)

N67-29845# Illinois State Water Survey, Urbana.

SUMMARY OF 1966 HAIL RESEARCH IN ILLINOIS

Stanley A. Changnon, Jr. 29 Dec. 1966 41 p refs Prepared for Crop-Hail Insurance Actuarial Assoc., Chicago

(CHIAA-RR-33) CFSTI: HC $3.00/MF $0.65

Studies were conducted to determine the probabilities for the areal extent of damaging hail in fixed areas of 1000 and 3000 square miles in Illinois. Information on the likelihood for various amounts of damaging hail in fixed areas is important in an understanding of hail production in Illinois, and also has relevance in making decisions about the amount of liability that should be assumed in an area. A detailed investigation of damaging hailstorms in central Illinois during the early morning of 11 July 1966 was made. This study was concerned primarily with the surface characteristics of the hail and the causes for these unusual nocturnal hailstorms. A collection and analysis of historical hail records from 225 U.S. Weather Bureau stations in Indiana, Michigan, and Wisconsin is also presented. Author

N67-29936# France. Direction de la Meteorologie Nationale, Paris.

CLIMATIC ELEMENTS DATA CONCERNING THE COASTLINE OF METROPOLITAN FRANCE [ELEMENTS CLIMATOLOGIQUE CONCERNANT LES COTES DE LA FRANCE METROPOLITAINE]

J. Darchen Feb. 1967 143 p

(Rept.-59)

Monthly and annual data collected by stations along the coastline of metropolitan France cover wind conditions, state of the sea, visibility, and air temperature. Observation conditions and

geographical location are given for the 6 stations on the North Sea, 4 on the Atlantic Ocean, and 7 on the Mediterranean Sea. Transl. by M.W.R.

N67-29974 Joint Publications Research Service, Washington, D. C.
RESULTS OF THE WORK OF THE CAUCASUS ANTI-HAIL EXPEDITION: 1965
G. K. Sulakvelidze 13 Jun. 1967 85 p refs Transl. into ENGLISH of "Rezul'taty Rabot Kavkazskoy Protivogradovoy Ekspeditsii" Leningrad, 1966
(JPRS-41365; TT-67-31999) CFSTI: HC $3.00

The results of research on the hail processes and the new concepts concerning the mechanism of precipitation formation are examined, the principle and means of influencing the hail processes are presented, the work organization for influencing the hail processes during the protection of large areas under various physical-geophysical conditions are described, the results of tests aimed at influencing the hail processes are examined, the total results of the research conducted are summarized, and recommendations are presented for the introduction into the national economy of the procedure for influencing the hail processes. This work is intended for specialists working in the field of atmospheric physics and those whose efforts are aimed at actively influencing hail processes. Author

N67-30157*# Israel Program for Scientific Translations, Ltd., Jerusalem.
AEROLOGY
V. A. Belinskii and V. A. Pobiyakho 1967 394 p refs Transl. into ENGLISH of the book "Aerologiya" Leningrad, Gidrometeorol. Izd., 1962 Published for NASA and NSF
(NASA-TT-F-268; TT-65-50006) CSCL 04B

The basic up-to-date methods of aerological measurements used in Soviet aerological stations and observatories are described. Aerological methods and instruments which have not yet come into standard use, as well as some obsolete methods, are also briefly considered. The chapters cover wind velocity measurements by pilot balloons; aerological instruments and methods of measurement; atmospheric sounding by aircraft, radio, and rockets; radar wind observations; some problems of radio meteorology; drifting balloons; and determining upper and lower boundaries of clouds. The essential points of indirect methods of studying the atmosphere are described along with a brief outline of the history of the development of aerological investigation, both in the USSR and abroad. Some results of the international collaboration of aerologists are reported as well as the achievements of the USSR in the study of space and the upper atmosphere. R.N.A.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-29145*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT CONTROL
In its Space Programs Sum. No. 37-44, Vol. IV 30 Apr. 1967 p 37-47 refs (See N67-29141 16-34)

System requirements, description, and analysis are summarized, and the initial breadboard tests are described for the advanced horizon scan platform. Efforts in calibrating the photoelectric pickoff system, replacing the strain gauge approach, are discussed for application to attitude control nozzle thrust measurements. The cruise gas consumption requirement for a general spacecraft is estimated as a function of spacecraft weight, considering a 200-day mission and a spacecraft less than 200-lb. The mathematics and data are presented, and it is concluded that the cruise gas consumption depends more on disturbance torque level than it does on the zero disturbance torque situation. N.E.N.

N67-29146*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GUIDANCE AND CONTROL RESEARCH
In its Space Programs Sum. No. 37-44, Vol. IV 30 Apr. 1967 p 48-64 refs (See N67-29141 16-34)

The temperature dependence of the velocity of sound in liquid helium is discussed, and the relationships among the first and second derivatives of parameters with respect to density are developed. Boundary trapping in unipolar space-charge-limited current is discussed, along with the volt-ampere characteristic. It is pointed out that the two limiting cases of uniform trapping throughout the base without boundary trapping and boundary trapping at the emitter without volume trapping can be distinguished. The applications of superconducting devices such as active to spacecraft are outlined for the following areas: switching devices, linear amplifiers, and parametric amplifiers; random access and associative cryoelectric memories; and high-field solenoids for shielding and masers. A test thermionic converter having an interelectrode gap of 28 mils and emitter side walls kept at the temperature of the planar part of the emitter was designed and fabricated, and the tested characteristics are presented. N.E.N.

N67-29320*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
THE ORBITAL RECOVERY PROBLEM. PART II: APPLICATION OF ANALYSIS TECHNIQUE TO SELECTION OF RECOVERY SITES FOR RETURN FROM LOW CIRCULAR ORBITS
Paul F. Holloway and E. Brian Pritchard Washington, NASA, Jun. 1967 52 p refs
(NASA-TR-R-260) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The problem of return from a circular orbit at an altitude of 150 nautical miles to land recovery sites is treated from two viewpoints: First, the recall capability for return of several classes of entry vehicles with lateral range capabilities of 210 to 3000 nautical miles to three sites located in the American quadrant of the Northern Hemisphere is defined. The effect of the addition of one optimally located emergency site to a network of three prime sites is also determined. Second, the minimum number of recovery sites necessary to support return to earth once per orbit (quick return) are defined for vehicle lateral range capabilities of 270 to 3000 nautical miles, orbital inclinations of 30°, 45°, 60°, 75°, 90°, all orbital inclinations in the range of 30° to 90°, and recovery sites with existing runways at least 8000 feet in length at which military and/or civilian aircraft of the United States are currently permitted to land. Finally, the return of spacecraft with vertical landing capability to large landing areas is considered. Author

N67-29367# National Aeronautics and Space Administration, Washington, D. C.
STATUS OF GUIDANCE AND CONTROL METHODS, INSTRUMENTATION, AND TECHNIQUES AS APPLIED IN THE APOLLO PROJECT
Walter Haeussermann and Robert Clifton Ducan *In* AGARD Orbit Optimization and Laser Appl. Oct. 1964 p 257-484 refs (See N67-29361 16-30)

Launch vehicle inertial navigation, guidance, and control; Saturn launch vehicle hardware; and space vehicle navigation and guidance methods and systems are detailed in relation to the Apollo Project. Inertial guidance schemes are discussed in general, some specific examples are given, and guidance equations are verified. The section on Saturn hardware includes descriptions of the overall launch vehicle system and signal flow, the stable platform,

digital computer and data adapter, control computer and control sensors, and thrust vector control servoactuators. Accelerated flight navigation methods are discussed, as are optical navigation during free flight and the space vehicle's inertial system. Theoretical aspects of navigation, guidance, and control and their inter-relationships are considered; along with the actual methods, techniques, and instrumentation. M.W.R.

N67-29813# Collins Radio Co., Cedar Rapids, Iowa.
COMPUTER/SIMULATION STUDY OF AIR-DERIVED SEPARATION ASSURANCE SYSTEMS IN MULTIPLE AIRCRAFT ENVIRONMENT
R. D. Joy, D. E. Killham, and L. K. Belden Mar. 1966 209 p
(Contract FA-WA-4598)
(RD-65-35; IR-2; AD-650821) CFSTI: HC $3.00/MF $0.65

The performance of two classes of air-derived separation assurance systems (ADSAS) were investigated by analytical means, and the most promising system was further studied by computer simulation methods. The two ADSAS classes studied were the range-altitude (R-A) technique using as a primary hazard predictor, tau, the ratio of range to range-rate and the relative position-velocity technique using both tau and the normal velocity component as hazard predictors. Primary emphasis was placed upon the R-A system using time/frequency ranging techniques. The parameters of this system were varied to maximize its performance. It was concluded: Range-altitude systems based upon the use of time/frequency ranging techniques showed hazard prediction performance superior to those available from the ground-bounce ranging techniques or the relative position-velocity system based upon interrogation-transponder ranging techniques. The time/frequency R-A system gives adequate rectilinear flight performance with rms range measurement errors of 2000 feet and range-rate errors of 30 feet per second. While the simple R-A system will offer complete protection in rectilinear flight regimes, it has serious deficiencies in turning encounters. The use of projection techniques can provide adequate protection for all expected encounters in both en route and terminal areas. TAB

N67-29819*# Philco Corp., Palo Alto, Calif. Western Development Labs.
INTERPLANETARY NAVIGATION AND GUIDANCE STUDY. VOLUME I: SUMMARY, OCTOBER 30, 1966
Huntsville, Ala., Marshall Space Flight Center, 28 Mar. 1966 43 p refs
(Contract NAS8-11198)
(NASA-CR-61129; WDL-TR2629, Vol. I) CSCL 17G

To establish the navigation and guidance system requirements for an Earth–Mars round-trip mission, general analysis techniques were developed. These include a statistical error analysis of the navigation and guidance systems for the midcourse and orbital phases of the Earth-Mars mission. A 532 day round-trip trajectory is used which is based on a 1975 launch opportunity and has high energies for both the outbound and return phases. Four navigation system configurations are evaluated under the assumption that observation data are processed with a minimum variance Kalman filter to estimate the vehicle state. Summary data are presented on the navigation and guidance theory, the computer simulation, and the onboard measurement techniques. The principal results are discussed for the outbound midcourse, the return midcourse phase, and the Mars orbital phase. Author

N67-29820* Philco Corp., Palo Alto, Calif. Western Development Labs.
INTERPLANETARY NAVIGATION AND GUIDANCE STUDY. VOLUME II: TECHNICAL REPORT, OCTOBER 30, 1966
Huntsville, Ala., Marshall Space Flight Center, 28 Mar. 1966 184 p refs
(Contract NAS8-11198)
(NASA-CR-61130; WDL-TR2629, Vol. II) CSCL 17G

Detailed results are presented on the navigation and guidance analyses of requirements during the midcourse and orbital phases of a 1975 round-trip Mars mission. Four navigation system configurations are evaluated, based on the assumption that the observation data are processed with a minimum variance Kalman filter to estimate the vehicle state. It was found that the best overall accuracies for any of the systems are obtained with Deep Space Instrumentation Facility (DSIF) tracking and onboard sextant observations. This results in position and velocity uncertainties of 0.2 km and 0.15 m/sec, respectively, at the end of 72 hours of tracking. The digital computer simulation program is described, along with the special onboard navigation techniques that were developed. Statistical error analyses are included on the outbound midcourse phase, the return midcourse phase, and the orbital phase. M.G.J.

N67-30019 Joint Publications Research Service, Washington, D. C.
FRENCH EXPERT OUTLINES DEVELOPMENT AND NATURE OF INERTIAL NAVIGATION
P. Hugon 15 May 1967 21 p Transl. into ENGLISH from La Rev. Maritime (Paris), Feb. 1964, p 190–206
(JPRS-41031; TT-67-31673) CFSTI: HC $3.00

Elementary rules and limitations of inertial navigation are discussed and the development of equipment used in inertial navigation is outlined. S.C.W.

N67-30027*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
A SIMULATOR STUDY OF A PICTORIAL NAVIGATION DISPLAY IN INSTRUMENT DEPARTURES OF THE SUPERSONIC TRANSPORT
Norman S. Silsby and Michael C. Fischer Washington, NASA, Jul. 1967 22 p refs
(NASA-TN-D-4029) CFSTI: $3.00 CSCL 17G

In order to assess the merits of a pictorial navigation display for the supersonic transport, a study was conducted in which a north-oriented moving-map-type pictorial display was used for navigating along specified departure routes. The pictorial display was mounted in the supersonic transport (SST) ground-based simulator and the tests were to study the problems connected with the introduction of the supersonic transport into the air traffic control system. The tests indicated that the deviations from course for the runs in which the pictorial display was used were generally small and of the same order as those using conventional navigation instrumentation. A reduction in the communication workload in the terminal area was realized with the use of the pictorial display; however, it was the opinion of the pilots that the total workload (communication and navigation) was increased as compared with the workload when conventional navigation instrumentation is used. The time and fuel used for the SST departures utilizing the pictorial display did not indicate any improvement in consistency as compared with the time and fuel used for departures in which the SST was radar vectored through the terminal area. Pilot opinion concerning the features of the pictorial display were generally favorable; however, there were recommendations for relocating the display unit directly in front of the pilot and for improving the readability of the information depicted on the screen. Author

N67-30139* Boeing Co., Seattle, Wash. Aerospace Group.
STUDY OF NAVIGATION AND GUIDANCE OF LAUNCH VEHICLES HAVING CRUISE CAPABILITY. VOLUME I: SUMMARY REPORT Final Report, 10 Jun. 1966–10 Mar. 1967
10 Apr. 1967 31 p refs
(Contract NAS2-3891)
(NASA-CR-73100; D2-113016-4) CSCL 17G

The navigation and guidance of a launch vehicle with a hypersonic airbreathing first stage and rocket second stage is considered. Detailed studies were conducted to define the technological problems and feasible solutions for hypersonic vehicles, as well as determining the capabilities and limitations of navigation and guidance systems for the two stage launch vehicle. The basic mission is to fly a 3704 km offset distance from an airfield to the orbital plane of a satellite, turn into the plane and separate the second stage which then accomplishes rendezvous of the payload with a satellite in a 485 km circular orbit. A comparative analysis of a number of alternate navigation and guidance concepts was conducted as the first phase of the study. Second phase efforts focused on the near-optimum nominal flight path, guidance, navigation guidance equipment, reliability and safety, cost, and critical research areas. S.P.

N67-30152* Boeing Co., Seattle, Wash. Aerospace Group.
STUDY OF NAVIGATION AND GUIDANCE OF LAUNCH VEHICLES HAVING CRUISE CAPABILITY. VOLUME 2. TRAJECTORY PARAMETRIC AND OPTIMIZATION STUDIES Final Report, 10 Jun. 1966–10 Mar. 1967
D. S. Hague and C. R. Glatt 10 Apr. 1967 119 p refs
(Contract NAS2-3691)
(NASA-CR-73101; D2-113016-5) CSCL 17G

Evaluated was the nominal flight profile for a two-Stage launch vehicle mission to fly a 3704 km offset distance to the orbital plane of a satellite to rendezvous with return to base. The stage 1 flight profile was parametrically analyzed by breaking the trajectory in subarcs or segments; a steepest descent trajectory optimization computer evaluation obtained a payload into orbit capability of 13,720 lbs. for this approach. Optimization of the complete Stage 1 and Stage 2 trajectory gave a payload in orbit capability of 17,690 lbs: this represented a 29% performance increase. G.G.

N67-30161*# Boeing Co., Seattle, Wash. Aerospace Group.
STUDY OF NAVIGATION AND GUIDANCE OF LAUNCH VEHICLES HAVING CRUISE CAPABILITY. VOLUME 4: DETAILED STUDIES OF TWO SELECTED NAVIGATION-GUIDANCE CONCEPTS Final Report, 10 Jun. 1966–10 Mar. 1967
J. A. Retka, D. Harder, D. S. Hague, C. R. Glatt, T. Seavoy et al D. Minden 10 Apr. 1967 214 p refs
(Contract NAS2-3691)
(NASA-CR-73103; D2-113016-7) CSCL 17G

The results of the Phase II study of the two selected navigation-guidance concepts, are presented. The Phase II study emphasized four tasks: (1) Further work on optimization of the nominal flight profile for the rendezvous mission, (2) Study of advanced rendezvous guidance techniques, specifically, the lambda matrix guidance technique, (3) Description of the explicit rendezvous guidance techniques developed by more conventional procedures, and (4) Description of the hardware mechanization, crew displays and controls, and operational studies. This emphasis resulted from the judgement at the conclusion of the Phase I study that the rendezvous navigation-guidance function is feasible within the state-of-the-art for the hypersonic Stage 1/Rocket State 2 launch vehicle. This is a distinct contrast with structure and propulsion problems for this launch vehicle. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-29017*# International Information, Inc., Philadelphia, Pa.
INFLUENCE CURVES FOR CALCULATION OF THE STRUCTURAL DISTORTION EFFECT ON REACTIVITY [COURBES D'INFLUENCE POUR LE CALCUL DE L'EFFET DES DISTORSIONS DE LA STRUCTURE SUR LA REACTIVITE]
F. Storrer Washington, NASA, Jun. 1967 16 p refs Transl. into ENGLISH from Proc. of the Seminar on the Phys. of Fast and Intermediate Reactors, 1961 p 1–17 Seminar held 3–11 Aug. 1961; Sponsored by Intern. Atomic Energy Agency
(Contract NASw-1499)
(NASA-TT-F-11045) CSCL 18L

A method is presented which permits the calculation of the counter-reaction to the reactivity which results from expansion and distortions of various components and structural elements of a fast reactor. The integral for the counter reaction is given in terms of temperature, time, and local temperature coefficient. Analytic formulas are presented in their most general form for: (1) displacements as a function of temperature, (2) reactivity as a function of the displacements, and (3) reactivity as a function of the temperatures. Examples of calculations are given for the expansion of the refrigerant and the axial expansion of the fuel elements of the core, and emphasis is place on the bending of couplings, both in the isostatic case and the simple hyperstatic case. It is felt that the method presented is useful in stationary systems, and is necessary in the case of transits. N.E.N.

N67-29168*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN OF GAS-COOLED TEST LOOP FOR NASA PLUM BROOK REACTOR FACILITY
Anthony J. Diaguila, Thomas Dallas, James F. Saltsman, Carl J. Wenzler, Arthur A. McGill et al Roy H. Springborn Washington, NASA, Jun. 1967 124 p refs
(NASA-TM-X-1393) CFSTI: $3.00 CSCL 18L

A recirculating gas-cooled inpile loop facility is described. The inpile section of the loop is designed to fit into the horizontal test hole, HT-1, of the Plum Brook reactor facility. The thermal neutron flux in HT-1 is 4×10^{14} neutrons per square centimeter per second. Pertinent features of the loop are as follows: (1) The main coolant system is a closed loop filled with helium gas at a pressure of 200 pounds per square inch absolute. (2) Test specimens generating up to 200 kilowatts of nuclear heat can be investigated in the loop. (3) A bypass flow arrangement in the helium gas system allows the gas flow rate through the test section to be varied from 0.06 to 0.24 pound per second. (4) Maximum gas temperature in the test section is limited by the physical properties of the removable test section. (5) Double containment is used throughout the main coolant system to prevent any fission products from eminating from the experiment. (6) The loop is packaged for movement between the reactor and the radioactive materials handling laboratory, or hot lab. Instrumentation is provided at the test section so that heat transfer and gas flow dynamic characteristics of reactor fuel element configurations can be obtained. Author

N67-29172*# Aerojet-General Corp., Azusa, Calif. Von Karman Center.
SNAP-8 PERFORMANCE POTENTIAL STUDY Final Report, 27 Jul. 1965–31 Dec. 1966
Apr. 1967 204 p refs
(Contract NASw-1298)
(NASA-CR-72254; Rept.-3386) CFSTI: HC $3.00/MF $0.65 CSCL 18N

The study is an evaluation of the performance of the developmental SNAP-8 electrical generating system (EGS). The objective of the study is to assess the improvement in overall efficiency, weight, radiator area, and power output that can be

realized by specified modifications of the system or its components. This final report describes the work performed and the results obtained. The performance characteristics and weight compilation of the current SNAP-8 EGS are presented and compared with similar data for six improved systems incorporating various modifications. The study also included an investigation of the SNAP-8 power system integrated with a direct-broadcast TV satellite vehicle in synchronous orbit. Finally, an assessment was made of the potential for increasing the operating life of the SNAP-8 system from 10,000 to 20,000 hours. The results of these studies also are given in the report. Author

N67-29264# Los Alamos Scientific Lab., N. Mex.
STATE-VARIABLE FEEDBACK CONTROL OF COUPLED NUCLEAR SYSTEMS
Hugh S. Murray and James L. Melsa (Arizona Univ.) 1967 21 p refs Presented at Am. Nucl. Soc. Coupled Reactor Kinetics Conf., College Station, Tex.
(Contract W-7405-ENG-36)
(LA-DC-8352; CONF-670107-5) CFSTI: HC $3.00/MF $0.65

The advantages of state-variable feedback control is presented. Great flexibility in the method may specify exactly the desired system response subject to the constraints imposed by the internal variable behavior. The resultant systems do not in general exhibit stability problems with increases in gain, and the designed system can be made relatively insensitive to the gain. The fact that delayed neutrons are ignored distracts from the reality of the results. Some useful results such as those which arise from the consideration of cores with temperature effects and from the examination of multicore systems appear. If delayed neutrons are included in the reactor dynamics, they are in inaccessible states, since the precursor density cannot be measured. These state variables may be generated from their describing equations. In conventional compensation designs, networks must be designed, and since the structure of state-variable feedback controllers is uncomplicated to begin with, the addition of the minor loops required for state-variable generation is not a serious problem. Author (NSA)

N67-29268# Atomic Energy Commission Research Establishment, Riso (Denmark).
FUEL LEAKAGE DETECTION IN WATER REACTORS. A REVIEW
Vlada Teodosic Dec. 1966 33 p refs
(RISO-M-496)

A general review of failed element detection and location systems for water-cooled reactors, with a particular attention to the DK-400 project is presented. Release ratios ρ, signal to background ratios D, and discrimination ratios R are discussed and evaluated, and a description of existing FEDAL systems is given. The influence of the state of the reactor core on important parameters for a FEDAL system is discussed in appendices. Author (NSA)

N67-29277# Oak Ridge National Lab., Tenn.
MANUFACTURE OF NUCLEAR REACTOR FUEL ELEMENTS AND THEIR COATING WITH PYROLYTIC CARBON
G. Fleischhauer, K. Hackstein, H. Huschka, and P. Venet [1966] 19 p refs Transl. into ENGLISH from Ber. Deut. Keram. Ges. (Bonn), v. 43, Mar. 1966 p 231–238
(ORNL-TR-1417) CFSTI: HC $3.00/MF $0.65

Recently interest has grown in the use of coated particles as fuel and fertile elements in high temperature nuclear reactors. At NUKEM the following work was carried out aimed at the manufacture of nuclear fuel elements from fused carbides and their coating with pyrolytic carbon. The manufacture of Grunling particles composed of oxide and carbon can be carried out both by granulation and by sol-gel processes. After reacting the particles at 1400 to 2000°C to form the carbide, they are melted at about 2550°C. The coating of the particles was carried out in 1 kg charges through the pyrolysis of methane in a rotating furnace and a fluidized bed apparatus. A variety of types of layer could be produced at temperatures from 1400 to 2000°C. Particular advantages in economy and quality were attained by coating in vacuum. Author (NSA)

N67-29278# Oak Ridge National Lab., Tenn.
FLUIDIZED BED COATING OF FUEL PARTICLES WITH PYROLYTIC CARBON
P. Koss [1966] 17 p refs Transl. into ENGLISH from Ber. Deut. Keram. Ges. (Bonn), v. 43, 1966 p 239–245
(ORNL-TR-1418)

The fluidized bed coating of fuel particles with pyrolytic-carbon is described. By using porous plates instead of nozzles for the introduction of the coating gases into the reaction vessel, it was possible to obtain batch sizes of up to 5 kg. The structure of the coatings as a function of methane concentration and temperature was investigated. Methods for the evaluation of coated particles are described with special emphasis on surface contamination, fission product retention, and the formation of reaction zones in the coating. Author (NSA)

N67-29331# Hittman Associates, Inc., Baltimore, Md.
LOW ENRICHED PM REPLACEMENT CORE Final Design Report
Robert Baer 20 Dec. 1966 97 p refs
(Contract AT(30-1)-3583)
(HIT-3583-43, Vol. 2) CFSTI: HC $3.00/MF $0.65

Information and data related to HIT-3583-43 (Vol. 1) are presented as appendixes concerned with core stress analysis, fission gas pressure, burnable poison element particle self-shielding, calculation of reactivity coefficients, fuel pellet thermal expansion, temperature distributions, and analog study equations and constants. NSA

N67-29332# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
REACTOR PRIMARY COOLANT SYSTEM RUPTURE STUDY Quarterly Progress Report, Jul.–Sep. 1966
Nov. 1966 110 p refs
(Contract AT(04-3)-189)
(GEAP-5279; QPR-6) CFSTI: HC $3.00/MF $0.65

Tentative distributions are proposed of the real variations and of the uncertainties in the parameters affecting low-cyle metal fatigue failures. Equations were developed for cycles required to grow cracks through pipe walls, and for the variance of cycles to failure. Fatigue test results, which typically vary widely, are shown to be the largest contributor to the variance. Computer Code development continued with checkout progressing satisfactorily. This included work on the solution, stress, and preprocessor portions of the program. Nitrided WOL (Manjoine) specimens of low-C steel (cold-rolled, commercial grade) were tested at −195° to 81°C. As a part of the fracture toughness studies, the critical stress intensity factor, K_{IC}, calculated for each test temperature, showed a smooth increase with temperature. Results showed no difference between the nitrided material and controls which were not nitrided, provided only the second crack (pop-in) was considered. The first crack starting in the nitrided surface material yielded a different fracture toughness than the controls. Measurements of microhardness gradients across crack tip plastic zones in Type 304 stainless steel showed too much scatter to permit quantitatively mapping the plastic energy distribution about the crack tips. Charpy impact tests, both longitudinal and transverse, were made of the A-1068 plain carbon steel piping to be used for the prototype pipe test specimens. A difference was revealed in the transition (50% FATT) temperature in the two directions ranging from 50 to 90°F with

the transverse specimens (which yield a radial or axial crack with respect to the pipe), and from 20 to 50°F, in the longitudinal specimens (which yield a transverse or circumferential crack with respect to the pipe). Results obtained in the analysis of a circumferential through-wall crack in 6- and 24-inch pipe enable application of brittle fracture mechanics theory to a geometry not previously analyzed. Crack growth rate measurements were started in C steel plate specimens at 600°F. These tests are the first in the series intended to determine the effect of loading rate and hold time as well as the effect of higher temperature. Electron microfractography examinations of the fatigue fracture surfaces of specimens tested earlier yield excellent agreement with the crack growth rates measured by the macroscopic marker technique. A design analysis was done covering the crack initiation stage of failure of the initial prototype pipe specimens. It was determined that deflection control was most suitable—rather than strain or load control for the prototype fatigue tests. Also strain gage locations have been specified. NSA

N67-29339# Hittman Associates, Inc., Baltimore, Md.
LOW ENRICHED PM REPLACEMENT CORE, VOLUME I Final Design Report
Robert Baer 28 Nov. 1966 178 p refs
(Contract AT(30-1)-3583)
(HIT-3583-43, Vol. I) CFSTI: HC $3.00/MF $0.65

The core mechanical design, nuclear characteristics, and thermal-hydraulic performance are described. Analyses performed on the core such as those concerning fuel element analysis to establish tolerances and adequacy of the fission gas retention volume are described. The basis for control rod design is discussed. Analyses of the core nuclear characteristics revealed that power distributions are thermally acceptable throughout core life. Analyses of costs revealed that the core costs less than the previous fully-enriched PM cermet cores. NSA

N67-29681# Argonne National Lab., Ill.
EXPERIMENTAL BOILING-LIQUID-METAL FAST REACTOR
R. H. Armstrong and J. C. Carter Jun. 1966 83 p refs
(Contract W-31-109-ENG-38)
(ANL-7212) CFSTI: HC $3.00/MF $0.65

The existing facilities of the EBR-I installation are proposed for the purpose of investigating the characteristics of fast solid-fuel reactors in which liquid metal is boiling under controlled and observable conditions. An integral unit is designed to fit into the existing EBR-I core cavity and to connect to the existing auxiliary facilities; the technical aspects are discussed, and a test program is presented. Author (NSA)

N67-29682# Argonne National Lab., Ill.
COMPARISON AND ANALYSIS OF THEORETICAL DOPPLER-COEFFICIENT RESULTS FOR FAST REACTORS
R. N. Hwang and K. Ott Dec. 1966 18 p refs
(Contract W-31-109-ENG-38)
(ANL-7269) CFSTI: HC $3.00/MF $0.65

Comparison and analysis of the theoretical Doppler coefficient for fast reactors as calculated independently at ANL and KFK were made. The factors that affect the magnitude as well as the temperature behavior of the Doppler coefficient were examined in great detail. The results are indicative of the possible causes of significant discrepancies in the previous comparison of this kind. Author (NSA)

N67-29683# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
REACTOR FUELS AND MATERIALS DEVELOPMENT FOR FY 1966 Annual Progress Report
W. C. Francis and R. A. Moen ed. Nov. 1966 160 p refs
(Contract AT(10-1)-205)
(IDO-17218) CFSTI: HC $3.00/MF $0.65

Progress is reported on developments on U–Al intermetallic fuel systems, on compatibility of this material with matrix and cladding materials, and on new developments in cladding and coating materials. The results of dynamic corrosion tests are reported on several Al alloys developed for elevated temperature operation. This work also includes extensive investigation of electrodeless Ni coatings. The stability of dispersion fuels is discussed in considerable detail including the important contribution of initial porosity in restricting the uniform swelling resulting from the production of solid fission products. Accelerated swelling thresholds were measured by means of post-irradiation blister tests. The results of compression and gas release measurements on Be irradiated at reactor ambient and high temperatures are reported and compared with fractography studies. Diffusion coefficients were determined for He gas in Be. Fatigue measurements on Types SA302B and SA212B steels are reported, and the status of construction of an in-pile fatigue test facility is described. Work reported also includes developments in fabrication techniques, modifications to the microprobe for handling irradiated specimens, and failure analysis. Author (NSA)

N67-29695# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
THE APPLICATION OF SYNTHESIS TECHNIQUES TO THE CALCULATIONS OF THREE-DIMENSIONAL REACTIVITY COEFFICIENT DISTRIBUTIONS
J. L. Bear, F. D. Judge, and E. R. Venerus 1966 8 p refs Presented at the 14th Conf. on Remote Systems and Technol., Pittsburgh, Nov. 1966
(Contract W-31-109-ENG-52)
(KAPL-P-3186; CONF-661001-44) CFSTI: HC $3.00/MF $0.65

Flux, power distribution, and associated reactivity level of an array of three-dimensional reactors can be obtained by the multichannel synthesis techniques using perturbation theory. A multigroup theory formulation for reactivity change due to a change in material expressed in terms of perturbation theory is given. Solution of this expression with assumptions involved follows. Results of empirical comparisons are presented. NSA

N67-29701# Atomic Energy Commission Research Establishment, Riso (Denmark).
NUCLEAR PARTICLE TRANSPORT WITH EMPHASIS ON MONTE CARLO AND SHIELDING CALCULATIONS
Peter Kirkegaard Jun. 1966 111 p refs
(RISO-136)

A description is given of a number of methods of calculating the transport of neutrons and γ-rays, mainly in reactor shields. Emphasis has been laid on the Monte-Carlo technique. All the methods described have been programmed for the electronic computer GIER at Risö, and some of them also for the IBM 7090 computer at the Danish Technical University, Lyngby. A simple bulk shield program system has been developed which calculates the penetration of neutrons as well as γ-rays throughout a reactor shield. The neutrons are treated according to the removal–diffusion theory with one removal and one diffusion group. The γ-ray calculation relies on the buildup concept. An improved removal–diffusion neutron shielding program has been worked out, permitting an arbitrary number of removal and diffusion groups. A cross-section library with the elements most frequently encountered in shielding has been prepared. A general outline of the Monte-Carlo calculation method for problems in nuclear particle transport is given. Some minor reactor problems concerning self-absorption of γ-rays in fuel rods and distribution of the energy deposition on the various components of a fuel lattice cell are solved by the Monte-Carlo method. A Monte-Carlo γ-ray shielding program has been written, especially suited for laminated shields, in which case

it is superior to buildup methods. The program calculates the energy deposition rate throughout the shield as well as the dose rate at the external surface. Finally, a Monte-Carlo method for computing the axial neutron flux distribution in a short, absorbing rod is presented. Whenever possible, the calculations described in this report have been supported by experimental results. Author (NSA)

N67-29711# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

POWER REACTOR DESIGNS—AN ANNOTATED BIBLIOGRAPHY

E. R. Appleby comp. Oct. 1966 703 p refs
(Contract AT(45-1)-1830)
(BNWL-326) CFSTI: HC $3.00/MF $0.65

An annotated bibliography of power and heat reactor design studies, produced by computer printout of information available through December 1966 is presented. Sections of the Bibliography group the designs into broad reactor types, as listed in the Table of Contents. Each design is given an alpha–numeric code. Pagination follows this alpha–numeric order, with the reactor code number appearing at the upper right hand corner of each page. Tabs are provided for locating the sections. Author (NSA)

N67-29721# Bettis Atomic Power Lab., Pittsburgh, Pa.

EXAMINATION OF A FAILED ROD OPERATING WITH MOLTEN UO_2–ZrO_2–CaO FUEL

B. F. Rubin Dec. 1966 80 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-593) CFSTI: HC $3.00/MF $0.65

A 0.250-inch diameter Zircaloy-4 sheathed fuel rod containing dished-end pellets of ZrO_2 + 6.1 wt % CaO + 33.2 wt % UO_2 operated at high heat fluxes and with approximately half of the fuel volume in the molten state. It is postulated that contact between molten fuel and the tubing resulted in burn-through and rod failure. The rod operated at full power for 25 minutes after failure, which was sufficient time for intensive hydriding of the cladding to occur. Author (NSA)

N67-29722# Bettis Atomic Power Lab., Pittsburgh, Pa.

RELATIVE REACTION RATES IN SEED-BLANKET SLAB ASSEMBLIES WITH HYDROGEN-TO-THORIUM RATIOS OF 0.51, 1.55, AND 5.1

P. G. Johnson, C. J. Emert, J. D. Korsmeyer, S. Milani, J. A. Mitchell et al Dec. 1966 42 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-615) CFSTI: HC $3.00/MF $0.65

Lattice parameters were measured and calculated in ThO_2 blanket regions as a function of distance from seed regions in three one-dimensional seed-blanket slab cores. These cores contained ThO_2 blankets with H/Th atom ratios of 0.51, 1.55, and 5.1 to cover a wide range of blanket rod spacings of interest in power reactor design. The blanket regions were relatively narrow so that lattice parameter measurements were made in a nonasymptotic neutron spectrum. This situation is typical in seed-blanket power reactors where highly enriched seeds are separated by relatively narrow blanket regions. These experiments were performed to test the ability of the calculational model and the nuclear data to predict blanket parameters in an environment representative of a large seed-blanket reactor. Author (NSA)

N67-29723# Bettis Atomic Power Lab., Pittsburgh, Pa.

EPITHERMAL NEUTRON SPECTRA IN THE MATERIALS TESTING REACTOR

A. B. Rothman and E. D. McGarry Dec. 1966 18 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-642) CFSTI: HC $3.00/MF $0.65

Epithermal neutron spectra between 0.65 and 500 eV have been determined in three reflector locations of the MTR using resonance detectors. Results suggest that effects of crystalline binding in Be on spectra in the range of a few electron volts are similar to those attributable to chemical binding in water. Author (NSA)

N67-29724# Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortech-Ink.

EVALUATION OF REACTOR PHYSICS EXPERIMENTS ON THE COUPLED FAST-THERMAL ARGONAUT REACTOR STARK

L. Barleon, A. Bayer, Chr. Brueckner, K. Burkart, G. Fieg et al Sep. 1966 58 p refs Presented at the Intern. Conf. on Fast Critical Expt. and Their Analysis, Argonne, Ill., 10–13 Oct. 1966
(KFK-482)

STARK is a coupled zero-power reactor consisting of a suboritical fast core driven by a surrounding light-water moderated thermal zone. Four different fast core loadings, containing up to 107 kg ^{235}U, were investigated so far, one of them with a CH_2-mixture to simulate the spectrum of a steam-cooled reactor. A number of experiments were performed to obtain information on the neutron spectrum in the fast zone: spatial distributions of reaction rates were determined by fission chamber and foil techniques, differential neutron spectra were studied by proton-recoil proportional counters, and reactivity worths of samples were measured in the fast core with a square-wave pile oscillator. Also integral parameters of the entire system were obtained by various kinetic methods. The experimental results are compared with one-dimensional diffusion and S_4-calculations using the Russian 26-group cross-section set. The experimental data give no indication of larger deviations from the calculated spectra in the keV- and MeV-region, whereas discrepancies were found in the lower eV-region. The integral reactor parameters (neutron lifetime, critical mass, partition of reactor power between the zones) were found to agree reasonably well with the calculation. Author (NSA)

N67-29729# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.

LATTICE PHYSICS STUDIES Quarterly Progress Report for Period Ending 31 Jul. 1966

J. M. Neill 26 Aug. 1966 21 p refs
(Contract AT(04-3)-167)
(GA-7378; EURAEC-1719, QPR-1) CFSTI: HC $3.00/MF $0.65

Improved techniques for the design of water-cooled and water-moderated nuclear reactors are to be achieved through the study of lattice spectra, both cell-averaged and spatially dependent. The studies are to be made by the time-of-flight method in assemblies consisting initially of single or simple-multiple rod cell configurations. The data are to be compared to integral measurements such as spectral indices, disadvantage factors, and reactivity. The measurements are to be interpreted using the best known transport and diffusion theory codes available. Investigation of the most satisfactory scattering kernel for H_2O and cross section set for the fuel nuclides are also to be made. Experimental techniques are to be developed to allow measurements in more tightly packed lattices. Subsequent to the satisfactory development of the experimental techniques, spectral measurements are to be performed in lattices of specific interest to the Euratom program. This will include rods of varying enrichment of ^{238}U or ^{239}Pu at various spacings. Temperature and poison may be other allowable variables. The data are to be compiled, interpreted and correlated, and then distributed to other workers in the field. At the beginning of the research program, there are essentially two problem areas that require disposition. The first problem is the extraction from existing data on water lattices of the outstanding uncertainties in the calculations for these lattices. The second problem is the investigation of the limitations imposed by the time-of-flight apparatus, and the determination of what modifications are necessary to carry out the research program as efficiently as possible. Author (NSA)

N67-29730# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. For Pure and Applied Science.
SPATIALLY DEPENDENT THERMAL NEUTRON SPECTRA IN SLAB AND ROD GEOMETRIES
J. M. Neill and J. C. Young 4 Nov. 1966 43 p refs
(Contract AT(04-3)-167)
(GA-7508) CFSTI: HC $3.00/MF $0.65

Results of time-of-flight measurements of thermal neutron spectra in lattices are given. Comparisons between spectral measurements and theoretical predictions for slab and rod geometries are made. An analysis of the assumptions of theoretical calculations of spectral measurements is presented. NSA

N67-29741# Comitato Nazionale Per l'Energia Nucleare, Rome (Italy).
A METHOD FOR THE CALCULATION OF KINETIC PROBLEMS OF THERMAL REACTORS [UN METODO DI CALCOLO PER PROBLEMI DI CINETICA DEI REATTORI TERMICI]
F. Norelli and A. Pepino 1966 17 p refs In ITALIAN
(RT/FI/66/21)

Non-spatial reactor kinetics problems were solved by a Lanczos' perturbation of the linear operators, which is operated by minimum-norm, such as Legendre or Chebichev, polynomials. Aspects of the method were pointed out and the results, for simple mathematical and physical problems, are listed; a comparison is made between the "Fourier-like" method used and the classical "Taylor-like" step-by-step procedure. Author (NSA)

N67-29744# Oak Ridge National Lab., Tenn.
IRRADIATION OF FUELED GRAPHITE FOR ADVANCED HIGH-TEMPERATURE GAS-COOLED REACTORS
J. A. Conlin and C. W. Cunningham Mar. 1967 60 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1653) CFSTI: HC $3.00/MF $0.65

A series of six capsule-irradiation tests was made on cylindrical matrix-type fuel elements containing uncoated UC_2 particles or pyrolytic-carbon-coated UC_2 or $(U-Th)C_2$ particles. Those that contained uncoated fuel were encapsulated in low-permeability graphite as a barrier to fission-gas release. Fuel temperatures ranged from 2000 to 3500°F; power densities ranged from 10 to 300 W/cc; and burnups were up to 21 at.% ^{235}U. One capsule contained loose pyrolytic-carbon-coated fuel particles in sealed tubes, in addition to a matrix element. Fission-gas release was determined during irradiation by sampling the helium purge gas for analysis by gamma-ray spectrometry. Information on the overall stability of the fuels was determined by postirradiation examination. Information is also included on the design of the experimental equipment, operation, techniques, and fission-gas release. Author (NSA)

N67-29763# National Lead Co. of Ohio, Cincinnati.
CONSUMABLE-ELECTRODE ARC MELTING OF URANIUM
R. L. Schardt Mar. 1967 38 p refs
(Contract AT(30-1)-1156)
(NLCO-916) CFSTI: HC $3.00/MF $0.65

Electrodes for arc-melting were produced by vacuum-induction-melting U feedstock and casting it into 5-1/2-, 8-, and 9-inch-diameter molds. These electrodes were arc-melted in a vacuum into 7-, 7-3/8-, 10-, and 11-inch-diameter (production-size) ingots. Procedures for the arc-melting of U were established and the effects of the process on the residual impurity levels in the U ingots were determined. Metallographic studies showed that the inclusions were finely divided and evenly distributed. Chemical analyses indicated that no chemical refinement, except for a small reduction in hydrogen content, could be attributed to the arc-melting process. Limited cladding and reactor tests indicated that fuel cores fabricated from arc-melted U performed as well as cores from regular induction-melted stock. Author (NSA)

N67-29768# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
PRTR FUEL ELEMENT QUALITY CONTROL SYSTEM
J. P. Keenan and R. E. Sharp Jan. 1967 21 p refs
(Contract AT(45-1)-1830)
(BNWL-349) CFSTI: HC $3.00/MF $0.65

Details of quality control and inspection methods used in production of PuO_2–UO_2 fuel elements for PRTR are given. The system presented is a combination of process steps, product control, records, and assignment of responsibilities. NSA

N67-29772# Idaho Nuclear Corp., Idaho Falls.
PREPARATION OF H_2O AND D_2O SLOW NEUTRON SCATTERING KERNELS FOR ENDF USING MR TYPE MODELS
H. L. McMurry and L. J. Gannon (Phillips Petrol. Co.) Mar. 1967 24 p refs
(Contract AT(10-1)-1230)
(IN-1065) CFSTI: HC $3.00/MF $0.65

The way in which slow neutron scattering kernels are being prepared for the Evaluated Nuclear Data File (ENDF) at Brookhaven National Laboratory using calculations based on models for the structure of liquid H_2O and D_2O at several temperatures is described. The models for H_2O at elevated temperatures are simple modifications of the MR (McMurry–Russell) model for 22°C water which gives computed scattering in agreement with Brugger's MTR data. The models for D_2O are obtained by scaling the MR model to correspond with using the mass of the D atom in describing the vibrational frequencies and modes in D_2O. For each temperature parameters have been adjusted to optimize agreement with available data. The data calculated for ENDF are obtained directly from calculations using the models, except in regions where the $S(\alpha^2,\beta)$ vs β functions show sharp spikes due to transitions associated with the characteristics vibrations present in the models. This structure may not be realistic, and may present problems of interpolation in the use of the ENDF data. Therefore, a procedure for calculating smoothed $S(\alpha^2,\beta)$ data in such regions is described. Author (NSA)

N67-29781# Institutt for Atomenergi, Kjeller (Norway).
NORA PROJECT Progress Report, Oct. 1–Dec. 31, 1966
Jan. 1967 20 p refs
(Contract AT(30-1)-3498)
(IAEA-3498-16) CFSTI: HC $3.00/MF $0.65

Reactor operation time during the quarter was used for low-power noise experiments, experiments using the neutron generator, and measurements in connection with the experimental work on grey and black neutron absorbers in NORA UO_2–H_2O lattices. Pulsed neutron research is also reported along with research on cell parameters. NSA

N67-29785# Hahn-Meitner-Institut fur Kernforschung, Berlin (West Germany).
FISSION GAS RELEASE OF CYLINDRICAL UO_2 FUEL RODS (RARE GAS IN SOLIDS 33) [UEBER DIE SPALTGASABGABE ZYLINDRISCHER UO_2-SINTERKOERPER (EDELGASE IN FESTKOERPERN 33)]
J. Biersack Dec. 1966 34 p In GERMAN; ENGLISH summary
(HMI-B-49) CFSTI: HC $3.00/MF $0.65

The various processes of fission gas release are discussed. Fission gas diffusion (at 1000 to 1800°C) and gas release by moving bubbles (above 1800°C) are considered in detail. It was found that both cases can be treated quantitatively and that analytical expressions can be obtained for the fractional release. The calculations are performed for active as well as inactive fission gases, taking into account the radial temperature distribution within a long, cylindrical fuel element. The formulas are programmed for the use in digital computers. Author (NSA)

N67-29786# General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.

HIGH POWER DENSITY DEVELOPMENT PROJECT Quarterly Progress Report, Jun.–Nov. 1966

C. L. Howard and R. N. Duncan, comp. Dec. 1966 23 p refs
(Contract AT(04-3)-361)
(GEAP-5405; QPR-25; QPR-26) CFSTI: HC $3.00/MF $0.65

Twenty-three developmental fuel assemblies revealed gross fuel rod Incoloy cladding failure of peripheral fuel rods. All of these assemblies contained swage-compacted, arc-fused, powder UO_2 fuel. The fuel rods were clad with 0.011-inch-wall, collapsed, cold-worked, weld-drawn, Incoloy-800. All fractures were intergranular. The observed fractures appear to be similar to Type-304 stainless steel failures which are associated with environmental factors such as stress-assisted localized corrosion. Fission product activity release measurements on irradiated developmental assemblies indicated leaking fuel rods. Examination of these assemblies revealed no visible fuel rod failures. The Big Rock Point reactor was operated at nominally full power, 75 MW(e). The fission product activity levels increased rapidly, indicating that fuel rod failures were occurring despite the removal of high burnup assemblies containing stainless-steel-clad fuel rods. The exposures attained prior to the shutdown by the various assemblies which were inspected are summarized. NSA

N67-29789# Atomic Energy Commission, Washington, D. C. Div. of Research.

MUON CATALYSIS OF FUSION REACTIONS

Stephen O. Dean 2 Nov. 1966 19 p refs Presented at the 8th Ann. Meeting of Am. Phys. Soc., Boston, 2–5 Nov. 1966
(CONF-661115-1) CFSTI: HC $3.00/MF $0.65

Calculations of Jackson on possibility of achieving chain fusion reactions using muons in liquid DT resulted in widespread belief that a muon might catalyze 100 reactions during its lifetime, that capture of muon by helium reaction product prevents continuance of chain, and that process fails by factor five to yield energy balance. These calculations were based on theoretical capture rates. Fusion energy released was compared to energy supplied to protons. Fifty percent conversion efficiency of protons to negative muons was assumed. These questions are here reconsidered based on experimentally measured capture rates. It is shown that an average muon catalyzes only one reaction during its lifetime and hence that capture into helium orbits is not the limiting factor in chain. Accounting for pion production cross section, the process fails by factor 10^9 to achieve energy balance in Jackson's sense. More meaningful balance between fusion energy released and 140 MeV conversion energy for muon creation shows process is inherently incapable of yielding net energy release. Author (NSA)

N67-29794# Los Alamos Scientific Lab., N. Mex.

ADVANCED PLUTONIUM FUELS PROGRAM Quarterly Status Report, Jul. 1–Sep. 30, 1966

Oct. 1966 72 p refs
(Contract W-7405-ENG-36)
(LA-3607; QSR-1) CFSTI: HC $3.00/MF $0.65

Results of investigations concerned with the interactions of Pu-based fuels with Na, the release and distribution of fission products from irradiated fuel to Na, and methods of altering the fission-product distribution are reported. Data on the solubility of O_2 in Na at 124 to 300°C are tabulated. Activities in a study to define and measure parameters for cold trap design were devoted to design of a Na test loop. Synthesis and fabrication data and information on PuO_2, Pu carbides, and Pu nitrides are included. Results of phase studies of Pu–C, and U–Pu–C systems using differential thermal analyses are presented. Studies of self-irradiation damage in Pu ceramics reveal that the lattice parameters of normal isotopic composition Pu ceramics increase at a steady rate. A preliminary determination of the crystallographic atomic position for Pu_2C_3 using neutron diffraction was completed. Progress is reported on the use of EMF cells and vaporization studies to determine thermodynamic properties of ceramic fuels. Techniques using high-temperature calorimetry and thermal conductivity are described for determination of the thermodynamic properties of Pu ceramic fuels. Plans for testing the compatability of PuC–UC, and Pun–UN fuels with candidate cladding materials are outlined. Computer programs are being developed for application to reactor kinetics problems, and a burnup program, DTFBUR, to survey life histories of Pu-fueled fast reactors was completed. Progress is reported in development of evaluation methods for neutron cross sections used in reactor calculations. Design work on a high-temperature residual gas analyzer for Na system cover gas is reported. NSA

N67-29797# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.

INTERPRETATION OF DOPPLER COEFFICIENT MEASUREMENTS IN FAST CRITICAL ASSEMBLIES

E. A. Fischer Oct. 1966 22 p refs
(KFK-473) CFSTI: HC $3.00/MF $0.65

Analytical results are presented on Doppler experiments in which the reactivity change due to heating samples in fast critical assemblies are measured. A formalism is developed which allows calculation of reactivity changes due to sample heating. Author

N67-29800# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Reaktorphysik.

INITIAL EXPERIMENTS IN THE KARLSRUHE FAST CRITICAL FACILITY, SNEAK

P. Engelmann, R. Boehme, G. Bruhn, R. Durand-Smet, W. K. Foell et al Oct. 1966 52 p refs
(KFK-472) CFSTI: HC $3.00/MF $0.65

Discussions and data are presented concerning the simulation of fast power reactors, preparations for Na void experiments, and a proposed mockup for simulating the fission products in the SNEAK facility. NSA

N67-29806# Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu.

ELECTRONIC EQUIPMENT FOR THE CONTROL OF A REACTOR [ELEKTRONIKA APARATURA PRO RIZENI REAKTORU]

D. Blaho Dec. 1966 10 p refs In CZECH; ENGLISH summary
(UV-1632)

Electronic equipment is described for automatic control of reactors with moving detecting elements. The equipment processes the pulses from the neutron detector and supplies output signals for reactor and control of the positions of the detection elements. The electronic equipment consists of a linear pulse amplifier, a pulse discriminator, a linear and a logarithmic counting-rate meter, a comparison circuit, and protecting circuits. Author (NSA)

N67-29814# Oak Ridge National Lab., Tenn.

HISTORY OF THE AEC SODIUM COMPONENTS DEVELOPMENT PROGRAM, VOLUME I

H. W. Savage, ed. Dec. 1966 401 p refs
(Contract W-7405-ENG-26)
(ORNL-3955, Vol. I) CFSTI: HC $3.00/MF $0.65

The Na components development program is an effort to demonstrate competence for the design and fabrication of safe, reliable, and economical components for advanced sodium-cooled nuclear power plants. The development of the supporting technological reports includes the effects of Na on containment materials, measurement of impurities in Na, the Na equipment, heat exchangers for steam generation, and operating experience. Committee meeting reports are recorded. NSA

N67-29828# Brookhaven National Lab., Upton, N. Y.
ALLOWANCE FOR RESONANCE STRUCTURE OF FERTILE AND FISSILE NUCLEI IN FAST AND INTERMEDIATE REACTOR CALCULATIONS
N. Pucker 23 Aug. 1966 7 p refs Transl. into ENGLISH from Acta Phys. Austriaca (Vienna), v. 21, no. 3, 1966 p 283–289
(BNL-TR-119)

The self-screening properties of the resonances of heavy nuclei can be represented simply by polynomial functions. Through the connected separation and through the potential cross section, energy, and temperature dependence, a representation can be given for the group cross section that depends only on the potential cross section and on the group constants. The cross sections for ^{238}U and for ^{239}Pu in the cases E=100 eV and E=1050 eV are shown. The group cross section value of the two lowest groups of the 16-group law of Yiftah, Okrent, and Moldauer is compared with the present calculations for ^{238}U. . . NSA

N67-29829# Argonne National Lab., Ill.
STATISTICAL BASIS FOR THE APPLICATION OF THE DYNAMIC MODEL TO STATIONARY NUCLEAR REACTORS [STATISTICHESKOE OBOSNOVANIE PRIMENENIYA DINAMICHESKOI MODELI K STATSIONARNYM YADERNYM REAKTORAM]
Ben'yamin Kozik Dec. 1966 11 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 20, no. 1, Jan. 1966 p 21–26
(ANL-TRANS-415)

On the basis of the statistical theory of the processes of neutron multiplication, a precise expression was derived for the spectral density of the noise for power and stationary reactors. It has the form of the product of the square of the modulus of the transmission function of the reactor at some multiple, slightly dependent on the frequency. Author (NSA)

N67-29834# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
DEVELOPMENT OF A BORON CONCENTRATION METER Quarterly Progress Report, Period Ending 31 Jan. 1967
Feb. 1967 56 p refs
(Contract AT(30-1)-3690)
(WCAP-3690-2; EURAEC-1778) CFSTI: HC $3.00/MF $0.65

Laboratory and conceptual design studies were carried out in order to establish the probable operating characteristics of an in-line boron concentration meter for determining boron concentrations in the coolant of a closed cycle, water moderated and cooled power reactor. It was concluded that a mannitol-addition meter can be constructed that will measure boron concentration within a delay time of approximately 1 min. The accuracy of such a meter will be at least ±0.6% with manual or digital readout and at least ±1% with a null-bridge recorder. The use of a low temperature boron concentration meter reduces the quantity of mannitol (or fructose) required for measurement of the boron concentration but also decreases the measurement accuracy. Economics are also discussed. NSA

N67-29853# General Dynamics Corp., San Diego, Calif. General Atomic Div.
THE PRINCIPLES OF PLUTONIUM METALLOGRAPHY
F. L. Cochran 2 Nov. 1966 40 p refs
(Contract AT(04-3)-167)
(GA-7127) CFSTI: HC $3.00/MF $0.65

A review is presented on the optical metallography of Pu and some of its alloys. Topics discussed include: glove-box design philosophy; physical properties; preparation; mechanical grinding and polishing; electrolytic polishing; etching; autoradiography; high-temperature examination; quantitative examination; quantitative point count; replication; and remote systems. (84 references). NSA

N67-29854# Argonne National Lab., Ill. Reactor Engineering Div.
SECOND-ORDER EFFECTS AS RELATED TO CRITICAL COOLANT-FLOW VELOCITIES AND REACTOR PARALLEL-PLATE FUEL ASSEMBLIES
M. W. Wambeganss, Jr. Nov. 1966 24 p refs
(Contract W-31-109-ENG-38)
(ANL-7261) CFSTI: HC $3.00/MF $0.65

Second-order effects, removed by the linearization process, are retained in a stability analysis of the equation of motion of a flat fuel plate in a reactor parallel-plate fuel assembly. The second-order terms generate an additional stability criterion in the form of an upper bound (critical deflection) on the amplitude of quasistatic deflections for stable oscillations, or neutral stability, about the undeflected fuel plate position. The critical flows velocities are upper bounds to insure local stability about the undeflected plate position. A constant of proportionality relating the critical deflection to the initial channel depth is designated as a design constant. When assigned a value, the design constant defines critical coolant-flow velocities. Author (NSA)

N67-29856# Idaho Nuclear Corp., Idaho Falls. National Reactor Testing Station.
BURNUP DETERMINATION OF NUCLEAR FUELS Project Report, 1 Jul.–30 Sep. 1966
Frederick L. Lisman, William J. Maeck, Robert E. Foster, Jr., and James E. Rein, ed. Mar. 1967 35 p refs
(Contract AT(10-1)-1230)
(IN-1064) CFSTI: HC $3.00/MF $0.65

In a continuing program to develop methods for the accurate determination of the burnup of nuclear fuels, the main emphasis was the additional measurement of ^{235}U thermal fission yields for many stable and long-lived fission products and the development of an extraction, in-situ spectrophotometric method for the determination of the ^{99}Tc fission yields for ^{233}U and ^{235}U. A capsule containing a weighed quantity of highly enriched ^{235}U, irradiated to 31.6 atom percent fission, was dissolved and analyzed for the number of atoms of each uranium isotope and various stable and long-lived fission product nuclides. From these data, the capture-to-fission ratio (α) and absolute fission yields were determined. The value for α_0 is 0.1752±0.0028. The absolute thermal fission yields of ^{99}Tc for ^{233}U and ^{235}U were determined on each of four previously dissolved ^{233}U capsules and three ^{235}U capsules. The ^{99}Tc was separated from the dissolved capsule solutions by extraction of the tetrapropylammonium pertechnetate ion-association complex and was determined spectrophotometrically as the Tc(V) thiocyanate complex. Author (NSA)

N67-29861# Oak Ridge National Lab., Tenn.
REFERENCE STUDY FOR THE 1000 MWe STEAM-COOLED FAST BREEDER REACTOR (D 1)
A. Mueller, B. Eggers, and W. Haefele Aug. 1966 288 p refs Transl. into ENGLISH from Report KFK-392
(ORNL-TR-1541; KFK-392) CFSTI: HC $3.00/MF $0.65

A reference study for a 1000-MW(e) steam-cooled fast breeder reactor is presented. The selection of the most important parameters, a brief description of the installation, data tables, description of the reactor facility, reactor physics considerations and calculations, selection of materials and strength calculations, thermodynamics and cooling design, normal operating cycle, safety considerations, and economic factors are discussed. NSA

N67-29862# Los Alamos Scientific Lab., N. Mex.
ULTRA-HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) TRANSIENTS
John C. Vigil 1 Sep. 1966 25 p
(Contract W-7405-ENG-36)
(LA-3605) CFSTI: HC $3.00/MF $0.65

Three types of transients in the UHTREX reactor have been numerically evaluated. They are (1) withdrawal of one plug rod starting from near zero power, (2) withdrawal of one plug rod starting from 3 MW delayed critical, and (3) scrams from 3 MW delayed critical. None of these transients would result in serious damage to the reactor, although in case 2 fuel particle melting occurs if a power scram does not terminate the excursion. Also, stressing of the fuel elements may be significant in case 1. Author (NSA)

N67-29868# Idaho Nuclear Corp., Idaho Falls.
NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1966
Feb. 1967 75 p
(Contract AT(10-1)-1230)
(IN-1048) CFSTI: HC $3.00/MF $0.65

Values for β/Λ obtained recently in the ATRC using reactor noise techniques are reported, and the procedures for data analysis currently in use are described. Effects of flux trap experiments and outer shim positions on the ATRC power distribution are described. The importance of motion of ATR fuel assemblies induced by the operating conditions was evaluated. Although significant motion was calculated, the geometrical changes that result do not appear detrimental. Hydraulic testing of production ATR fuel elements was continued. Inadequate roll-swage-joint strength appears to be the cause of the premature failure of one fuel assembly. From a study of the physical, chemical, and metallurgical changes which take place in various fuel systems during irradiation, some of the fuel stability variables which reduce uniform fission product swelling and lower the accelerated swelling threshold temperature have been identified. Large differences in uniform swelling rates and in accelerated swelling temperatures from one system to the next suggest that control of these variables could result in greater fuel stability. The incorporation of initial porosity to accommodate uniform swelling from fission improves the irradiation performance of aluminum plate-type elements. Type 2219 aluminum alloy clad fuel plates have been corrosion tested in-pile under ATR conditions. Type 2219 aluminum in both the annealed (–0) and precipitation-hardened (T-62) condition appears superior to Type 6061-0 aluminum for application in the ATR. UAl alloys and intermetallics appear to be compatible with liquid lead for short periods (72 hours) at 600°C. For longer periods, varying reaction and lead penetration occur. Author (NSA)

N67-29870# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
POWDER DISPERSION MATERIALS FOR REACTOR PHYSICS MEASUREMENT
W. Rutkowski and W. Szteke Sep. 1966 19 p
(INR-751/XIV/PR) CFSTI: HC $3.00/MF $0.65

Techniques used to prepare dispersions of Dy_2O_3, Lu_2O_3, and H_3BO_3 in metals for measurement of neutron density and neutron spectral distribution are reported. Author (NSA)

N67-29872# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
MODEL FOR ANALYSIS OF FAST TRANSIENT REACTIVITY EFFECTS IN LOW-ENRICHED OXIDE-FUELED REACTORS
J. E. Houghtaling (M.S. Thesis) Dec. 1966 62 p refs
(Contract AT(10-1)-205)
(IDO-17224) CFSTI: HC $3.00/MF $0.65

A reactivity feedback model applicable to short-period power excursions in low-enriched oxide fueled reactors, and the application of this model to such a reactor recently tested in the Spert I facility are described. Performed in a manner consistent with current nuclear design practice, this application resulted in agreement between calculation and experiment within the estimated probable error of about 20% in the calculated reactivity compensation, exclusive of uncertainties in the resonance integral temperature coefficient, γ. While calculations gave best agreement with experiment for a value of γ intermediate between the theoretical value (obtained for the Spert I Core with digital nuclear codes) and available empirical values, agreement in terms of the theoretical value or of published empirical data is not excluded. These results suggest that the reactivity model may be applied to obtain reasonable estimates of reactor kinetic behavior applicable to accident analyses for a large and growing class of thermal reactors using low-enriched oxide fuel. Author (NSA)

N67-29873# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SPERT PROJECT QUARTERLY TECHNICAL REPORT, APRIL–JUNE 1966
T. G. Taxelius and R. M. Potenza ed. Jan. 1967 62 p
(Contract AT(10-1)-205)
(IDO-17207) CFSTI: HC $3.00/MF $0.65

Completion of the Spert-III E-Core static experiments including reactivity worth measurements and temperature coefficients of reactivity is reported. Capsule driver core tests were continued with the performance of 36 short-period transient tests in the period range from 6 to 4 msec. Most of these tests were conducted to determine if the neutron source data are reproducible. In Power Burst Facility (PBF) proof testing, single fuel rods were subjected to high operating temperatures. Other tests were conducted to determine the effects of fuel rod rupture on neighboring fuel rods. Titanium hydride mechanical stability tests were also conducted in the PBF. NSA

N67-29931 Societa Ricerche Impianti Nucleari, Saluggia (Italy).
BEHAVIOR OF "COATINGS" FROM PYROLYTIC CARBON UNDER RADIATION [VERHALTEN VON "COATINGS" AUS PYROLYTISCHEM KOHLENSTOFF UNTER BESTRAHLUNG]
H. Walther Jul. 1966 52 p In GERMAN Presented at the Labor Conference on Pyrocarbon of the Carbon Work Group in July 1966 in Karlsruhe
(M/259)

In producing fuel elements for gas-cooled, high temperature reactors, fuel particles of 400μ diameter are covered with a coating of 100μ to 200μ to attain maximum retention of fission products. Presented is a review of measurements to establish the release factor and to define the required retention capacity of the coatings. Concentration, activity, and production rate are given for several representative fission products at a thermal neutron flux of 10^{14} cm^{-2} sec^{-1}. Results of fuel diffusion are given for three pyrolytic carbon coatings after heat treatment for 300 hrs. at 1900°C. The physical processes affecting the release factor by causing stresses, fracture, and structural changes during production and irradiation of the particles are discussed. Transl. by K.W.

N67-29948 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
CONCISE CONSIDERATIONS OF THE FUEL CYCLE IN POWER REACTORS [BREVES CONSIDERACIONES SOBRE EL CICLO DE COMBUSTIBLE EN LOS REACTORES DE POTENCIA]
Guy Ledanois and Roberto Solanilla 1966 16 p refs In SPANISH Submitted for publication
(CNEA-183)

Reactor technological developments are reported for fuel combustion efficiency of the pressurized water reactor, the heavy water reactor, the water cooled reactor, and the gas cooled reactor. When calculating the cost of fuel elements, consideration is given to the following factors: price of the fissionable material selected, cost of industrial processes of manufacturing and reprocessing, and operating capabilities of the reactor. An example is given of a calculation of the most efficient combustion cycle. Transl. by R.Ll.

N67-29058*# Aerojet-General Corp., Azusa, Calif.
PERFORMANCE CHARACTERISTICS OF ETS-1 NUCLEAR EXHAUST SYSTEM. NERVA PROGRAM
Jun. 1964 53 p
(Contract SNP-1)
(NASA-CR-85231; TID-23851; RN-S-0099) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Test results of the ejector scale model test program as they apply to the full scale Engine Test Stand-1 (ETS-1) are presented. The evaluation concerns the performance envelope for the selected subsonic turn ejector system in the Nuclear Exhaust System (NES) for the ETS-1. The experimental tests were conducted on 1/8 scale models. As a result of the data obtained through this experimental and analytical evaluation, the design implications for the NES for ETS-1 have been drawn. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-28586# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
ATTENUATION OF MILLIMETER WAVELENGTH RADIATION BY GASEOUS WATER
James T. Hall Jan. 1967 45 p refs
(ECOM-5097; AD-650812) CFSTI: HC $3.00/MF $0.65

A theoretical computation for absorption by water vapor of radiation within the millimeter and submillimeter region of the electromagnetic spectrum permits the determination of attenuation coefficients for given water vapor densities, pressures and temperatures. The rigid asymmetrical top rotor approximation for all angular momentum quantum numbers J < or = 12 is used with the Zhevaklin-Naumov line shape and half-widths calculated by Andersons theory. An equation is given for extrapolating attenuation coefficients to pressures and temperatures other than those for which calculations were performed. Author (TAB)

N67-29013*# Farnum (Frank C.) Co., Philadelphia, Pa.
INTERFERENCE MEASUREMENTS OF MASS TRANSFER IN A TURBULENT BOUNDARY LAYER THROUGH A PERMEABLE SURFACE [INTERFERENTSIONNYYE IZMERENIYA MASSOPERENOSA V TURBULENTNOM POGRANICHNOM SLOYE PRONITSAYEMOY POVERKHNOSTI]
L. A. Feyngol'd Washington, NASA, Jun. 1967 7 p refs
Transl. into ENGLISH from the book "Teplo. i Massoobmen tel s Okruzhayushchey Gazovoy Sredoy" Minsk, 1965 p 123–129
(Contract NASw-1497)
(NASA-TT-F-11025) CSCL 20F

The main advantages of the interferometric method are discussed in comparison with other optical methods for studying the processes of heat and mass transfer. The method is employed to measure the concentration fields of an admixture (carbon dioxide) which is forced into a turbulent boundary layer through a permeable surface under isothermal conditions. The experiment is set up in an open wind tunnel with a closed operating range. The test medium is a stainless steel porous plate which is embedded in epoxy glue in a sectional box made from organic glass. The process inside the wind tunnel was photographed and the interferograms were subsequently interpreted. The capabilities of the IZK-454 interferometer for measuring carbon dioxide concentration are evaluated, and it is found that the noticeable displacement of the interference bands detected during microscopic analysis amounts to approximately 0.00001 m. Author

N67-29045# Naval Research Lab., Washington, D. C.
TABLES OF SPHEROIDAL WAVE FUNCTIONS. PART 2: PROLATE RADIAL FUNCTIONS OF THE FIRST AND SECOND TYPE
S. Hanish, R. V. Baier, W. H. Buckler, and Berthel K. Carmichael 31 Jan. 1967 385 p refs
(NRL-6502; AD-650575) CFSTI: HC $3.00/MF $0.65

The theory of prolate spheroidal wave functions is briefly reviewed. Formulas useful for the numerical calculation of prolate radial function of the first and second type, together with their first derivatives, are derived and explained. A step-by-step procedure of computation is then outlined together with an indication of precision achieved and method of checking. Finally a computer-printout tabulation of 66,600 entries comprising prolate radial functions and their first derivatives of both types is reproduced. The range of parameters m, l, h, and xi covered in these tables is m=0 and 1, l=m(1)18, h=0.1(0.1)1(0.2)8, and xi=1.01(0.01)1.10. Author (TAB)

N67-29100# Radiation Research Associates, Inc., Fort Worth, Tex.
LIGHT TRANSPORT IN THE ATMOSPHERE. VOLUME III: UTILIZATION INSTRUCTIONS FOR THE LITE CODES Annual Report, 1 Aug. 1966–31 Aug. 1966
Dave G. Collins, Michael B. Wells, and Kelly Cunningham Sep. 1966 220 p refs
(Contract DA-28-043-AMC-00240(E))
(RRA-T63-3; ECOM-00240-1, Vol. III; AD-650109) CFSTI: HC $3.00/MF $0.65

The Monte Carlo procedures designated as LITE-I and LITE-II were developed during a previous contract period for use in studying the transport of light through the earths atmosphere under various environmental conditions. These procedures were modified to expand their application to a broader range of physical problems. LITE-I treats monochromatic light emitted from a point source, and LITE-II treats monochromatic plane sources of light. The codes were written in both ALGOL for the Burroughs B-5500 and FORTRAN-IV for other computers. The codes are sufficiently flexible to treat multiple scattering in an atmosphere in which the air density and the aerosol size distribution vary independently and arbitrarily with altitude. Provision for treating ground and cloud reflection with an albedo method is also available in the codes. A machine procedure, designated as ACC, was developed for use in converting the scattered intensities computed by the LITE codes for a given ground albedo to scattered intensities for problems where only the magnitude of the ground albedo has changed. Utilization instructions, input data formats, sample problems and the ALGOL listings of ACC and the improved versions of the LITE programs are given to aid those who wish to utilize the codes. Author (TAB)

N67-29108# Radiation Research Associates, Inc., Fort Worth, Tex.
LIGHT TRANSPORT IN THE ATMOSPHERE. VOLUME I: MONTE CARLO STUDIES Annual Report, 1 Aug. 1966–31 Aug. 1966
Michael B. Wells, David G. Collins, and Kelly Cunningham Sep. 1966 109 p refs
(Contract DA-28-043-AMC-00240(E))
(ECOM-00240-1, Vol. I; AD-650107) CFSTI: HC $3.00/MF $0.65

The Monte Carlo codes LITE-I and LITE-II were used to compute light transmission data for point and plane sources. The results of these calculations showed that there is no correlation between the scattered transmission data for point isotropic and plane parallel sources. The LITE codes were used to analyze experimental data on light transport in the atmosphere. Reasonably good agreement was obtained for those cases where data were available to adequately describe the atmosphere at the time of the experiments. Calculations were performed to determine the

angular dependence of the number albedo from thick cumulus clouds for 0.45 light incident at various angles to the cloud. The polar angular distributions of the reflected photons were found to be cosine distributions and the total number albedo was expressed mathematically. Studies were performed to determine the sensitivity of the LITE-I calculated scattered intensities for a point isotropic monochromatic source to changes in the source and receiver altitudes, aerosol number density, aerosol phase function, altitude variation of the aerosol scattering coefficient and the altitude of the bottom of a cloud layer above the source point. It was found for the source-receiver geometry considered in these studies that the LITE calculations were more sensitive to changes in the number density of the aerosol particles than to changes in the shape of the aerosol phase function. Author (TAB)

N67-29109# Forest Products Lab., Madison, Wis.
DETERMINING SCATTERING AND ABSORPTION COEFFICIENTS BY DIFFUSE ILLUMINATION
F. A. Simmonds and C. L. Coens Apr. 1967 14 p refs
(FPL-0162; AD-651127) CFSTI: HC $3.00/MF $0.65

Opacity is a highly important use requirement of printing papers. Fundamental to the optical property of opacity are the light scattering and the absorptive powers of the paper. Two methods for measuring these optical properties of paper and pulp were evaluated and compared. A method using a reflectometer with filters was found to produce sufficiently accurate results in less time than a method in which a reflectometer with a monochromator was used. Author (TAB)

N67-29126# Radiation Research Associates, Inc., Fort Worth, Tex.
LIGHT TRANSPORT IN THE ATMOSPHERE. VOLUME II: MACHINE CODES FOR CALCULATION OF AEROSOL SCATTERING AND ABSORPTION COEFFICIENTS Annual Report, 1 Aug. 1965–31 Aug. 1966
K. Cunningham, M. B. Wells, and D. G. Collins Sep. 1966 137 p refs
(Contract DA-28-043-AMC-00240(E))
(ECOM-00240-1, Vol. II; RRA-T63-2; AD-650108) CFSTI: HC $3.00/MF $0.65

Two machine programs were developed for use in computing microscopic and macroscopic cross sections for light scattering and absorption by spherical-homogeneous aerosol particles with a complex index of refraction. The first of these programs computes microscopic cross section data by use of the Mie theory. The second program integrates the microscopic cross section data over aerosol particle size distributions to produce macroscopic cross section data. These codes were written in ALGOL for the Burroughs B-5500 computer and in FORTRAN-IV for other computers. Calculations obtained from these codes were compared with data reported by other investigators in order to verify their accuracy. A sizable quantity of aerosol cross section data was generated for several aerosol particle size distributions and the results are presented. In addition, a description of the calculational methods and instructions for utilization of the two codes on the B-5500 computer are given to aid those who wish to utilize the codes. Author (TAB)

N67-29235# Army Engineer Research and Development Labs., Fort Belvoir, Va. Night Vision Lab.
CHARACTERISTICS OF A 20-KW, LIQUID-COOLED, XENON ARC SEARCHLIGHT Final Exploratory Development Report, Jul. 1964–Mar. 1966
Steve B. Gibson, John A. Schmidtlein, Andy J. Rapasy and Daniel J. Horowitz Mar. 1967 37 p refs
(Rept.-2; AD-650881) CFSTI: HC $3.00/MF $0.65

A searchlight was developed using a 20-kw, compact, xenon arc lamp whose electrodes were internally water cooled. The procedure consisted of modifying a housing designed for a carbon arc lamp and mounting the xenon arc lamp coaxially. The performance of the experimental searchlight was measured, and it was found to exceed that of the carbon arc lamp searchlight in almost all desired categories. It is expected that, with future engineering and final development, this searchlight will eventually replace the carbon arc searchlight. Author (TAB)

N67-29414# Parke Mathematical Labs., Inc., Carlisle, Mass.
THE PHYSICAL INTERPRETATION OF WESTON'S TOROIDAL WAVE FUNCTIONS
W. Williams and C. H. Sherman Dec. 1966 46 p refs
(Contract N00140-66-C-0172)
(Rept.-0172-SR-2; SR-2; AD-649916) CFSTI: HC $3.00/MF $0.65

Weston's toroidal wave functions are shown to be interpretable as the field resulting from familiar spherical sources distributed on a ring. For the case of acoustic sources the physical interpretation is extended to show how particular wave functions are associated with certain motions of a ring. Author (TAB)

N67-29454# Southwest Center for Advanced Studies, Dallas, Tex.
ELECTROMAGNETIC SCATTERING FROM ABSORBING SPHERES
George W. Kattawar and Gilbert N. Plass 28 Dec. 1966 46 p refs
(Contract AF 19(628)-5039)
(SR-1; AFCRL-67-0129; AD-649806) CFSTI: HC $3.00/MF $0.65

An efficient method for the calculation of Mie cross sections for absorbing particles is discussed. It is used to calculate an extensive set of curves which illustrate the dependence of the efficiency factors Q for absorption, scattering, and extinction on the size parameter x and on n1 and n2 (the real and imaginary parts of the index of refraction). Among the interesting features shown are the following: (1) as n2 increases, Q(sca) decreases to a minimum value before increasing, when $x > or = 1$ and for most values of n1; (2) the maximum value of Q(ext) at the first resonance decreases rapidly when a small amount of absorption is introduced; (3) over a considerable range of the parameters the width of the first resonance of Q(ext) is proportional to (n1) to the -4th power when there is no absorption and to (n2n1) to the -2nd power when there is absorption; (4) when $n1 > > 1$, the scattered intensity near the first resonance is predominately forward, symmetrical, or predominately backward when x is respectively somewhat smaller than, equal to, or larger than the resonance value; (5) as n2 increases, the forward scattered intensity first increases before it decreases, when $x > or = 1$ and for most values of n1; (6) the half-width of the angular intensity function varies as $1/x$ when $x > or = 10$ and is relatively insensitive to the value of n1 and n2. Author (TAB)

N67-29699# California Inst. of Tech., Pasadena. Antenna Lab.
SCATTERING BY AN EXPANDING CONDUCTING SPHERE
John Lam Feb. 1967 28 p refs
(Contract AF 49(638)-1266)
(TR-40; AFOSR-67-0668; AD-649687) CFSTI: HC $3.00/MF $0.65

The scattering of a plane monochromatic wave by a uniformly expanding, perfectly conducting sphere is formulated as a boundary value problem in the space-time domain. The problem is then converted into an initial value problem of a linear ordinary differential equation of the Euler type. For velocity of expansion small compared to the velocity of light, this equation is solved approximately and the nature of the solution examined. Author (TAB)

N67-29610# Naval Research Lab., Washington, D. C.
SOME PRELIMINARY CALCULATIONS ON THE DIRECT TRANSMISSION OF LIGHT THROUGH A PLANE WATER SURFACE AND ITS RETURN BY A SUBMERGED RETROREFLECTOR Final Report
R. L. Denningham, L. F. Drummeter, Jr., and G. L. Stamm 3 Mar. 1967 28 p refs
(NRL-6432; AD-649839) CFSTI: HC $3.00/MF $0.65

When light passes through a plane water surface from the atmosphere and is reflected by a retroreflector having a flat glass entrance face, reflective losses occur at two interfaces: air-water and water-glass. In the report the general problem of computing round-trip transmission values for arbitrary relative orientations of the incidence planes at the water surface and the retrosurface is solved, and numerical computations of the effective transmissions for unpolarized light are presented for the coplanar case. The transmission depends on the angle between the direction of incident light and the normal to the interface and on the degree of polarization. The results show that high transmissions can exist, provided the light does not graze either the water surface or the entrance face of the retroreflector. When the light is incident normal to the water surface, the round-trip transmission is approximately 95 percent even when the incident angle at the retroreflector face is as much as 30 degrees; but this value is decreased by about one-half when the incident angle at the retroreflector is 80 degrees. Similarly, the transmission remains high when the direction of incident light at the water surface is inclined up to 30 degrees to the normal. Even when this angle is 85 degrees, the transmission is about 20 percent, provided the retroreflector is inclined properly. Light incident on the water surface from a given direction will be returned most efficiently by a retroreflector when its face is normal to the direction of the light after being refracted at the water surface. Author (TAB)

N67-29617# Utah State Univ., Logan. Electro-Dynamics Labs.
ESTIMATION AND DETECTION OF OPTICAL SIGNALS DISTORTED BY DIFFRACTION, BACKGROUND NOISE, AND DETECTION NOISE
Mark C. Austin and Craig K. Rushforth 31 Dec. 1966 231 p refs
(Contract AF 19(628)-3825; ARPA Order 450)
(SR-9; AFCRL-67-0071; AD-649667) CFSTI: HC $3.00/MF $0.65

Estimation and detection of optical signals distorted by diffraction, additive background noise, and multiplicative (detection) noise are studied. Assuming that the output of the detector is a Poisson process, that the signal and noise are additive, and that they have prescribed means and covariance matrices, the optimum linear estimate of the optical signal or object is obtained. In the physical detection process, the interaction between the incident radiation and the detector produces an effect called multiplicative noise which must be taken into account in obtaining the optimum linear estimate. The performance of the estimation procedure is evaluated for several special cases. Both white and colored noise are considered in the estimation problem. The problem of discriminating between optical signals is considered. Optimum procedures are derived for detecting known and unknown optical using fixed-sample detectors. The properties of sequential detectors which are optimum for the detection of random or unknown optical signals are investigated. A comparison is made of the average test lengths of these optimum random signal detectors with those of a detector designed for particular optical signals. The test lengths of the fixed-sample detector and sequential detector are compared for a particular example. Author (TAB)

N67-29707# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
DERIVATION OF EQUATIONS TO DETERMINE FREQUENCY DISTRIBUTIONS OF PARTICLE SIZE
G. A. Sehmel Oct. 1966 27 p refs
(Contract AT(45-1)-1830)
(BNWL-346) CFSTI: HC $3.00/MF $0.65

A method was developed for obtaining a mathematical expression which represents particle size frequency distributions when the measured distributions are originally specified in terms of size increments. The method is particularly applicable when a measured size distribution does not correspond to the normal, log-normal, and Weibull distributions. Nevertheless, the method is also applicable to these distributions over the limits of the experimental data. The method is an iterative least squares technique to fit a partial distribution function over the size range of the experimental data. Particle size data are represented which were initially grouped into seven size increments, but the method should have applicability to any number of size increments. Author (NSA)

N67-29786# Stanford Univ., Calif. Dept. of Mathematics.
REFLECTION FROM A PERIODICALLY COMPOSED HALF-SPACE
Harold Levine 1 Apr. 1967 29 p refs
(Contract Nonr-225(74))
(TR-10; AD-650424) CFSTI: HC $3.00/MF $0.65

The character of wave motions in geometrical settings of a periodic nature and their interplay with primary and secondary waves in the exterior of partly space-filling configurations receive prominence in the theories of x-ray and electron diffraction. It is customary to focus attention on the free or natural wave motions in unbounded media with a periodic bias prior to establishing the self-consistent solution for specific excitations in composite media. An integrated, rather than sequential, approach to problems in the latter category is recommended and detailed here in connection with the incidence of plane waves on a half-space with periodic composition normal to its boundary; and is shown, in particular, to furnish directly a superior means of calculating the reflection coefficient. Author (TAB)

N67-29971# Electrotechnical Lab., Tokyo (Japan).
COMPARISON CALIBRATION OF ACOUSTIC INSTRUMENTS IN DIFFUSE SOUND FIELD
Shozo Hattori Dec. 1966 113 p refs In JAPANESE; ENGLISH summary
(Rept.-669) CFSTI: HC $3.00/MF $0.65

Probabilistic considerations of the diffuse sound field are discussed and comparison calibration experiments are described. The statistical characteristics of a diffuse field driven with random single-frequency sources and with multifrequencies are reviewed, and an expression for the probability density is presented. The diffuse field with randomly placed microphones and sound source is considered, and the maximum standard deviation of the sound pressure level is determined. Details are given on the reverberation chamber with nonparallel walls. The diffuse field calibration of microphones is compared with the warble tone in the 300–8000 cps range. N.E.N.

N67-29972 Southampton Univ. (England). Inst. of Sound and Vibration Research.
COMPARISON OF DIFFERENT MATERIALS IN VIBRATING STRUCTURES
R. D. Adams and D. J. Mead Nov. 1966 94 p
(Contract N/CP12/3624/64/4B201/FB437)
(ISAV-158)

The displacement, velocity, acceleration, and transmissibility responses of a single degree of freedom system with hysteretic damping are derived for several commonly encountered sources of excitation. Criteria are deduced for comparing materials used under resonant conditions. The treatment is extended to cover the resulting cyclic strains and stresses and the importance of separating

the contributions to the overall stiffness of the elastic modulus and the geometry is demonstrated. Criteria are also presented for comparing materials under resonant fatigue conditions both for finite and infinite life. A method of determining the overall damping capacity of a structure also is given. It was found that the damping capacity is very important in reducing the resonant responses, these being inversely proportioned to the damping for harmonic excitation, although only to the square root of it for random excitation. The effect of the mass and stiffness was shown to vary considerably depending on the response concerned and the characteristics of the excitation. It is suggested that a material of high damping capacity but low fatigue strength may often be more successful in fatigue applications than high strength alloys when material damping is the major source of damping in the structure. Author

N67-30001* Volt Technical Corp., Washington, D. C.
INFLUENCE OF THE EARTH'S MAGNETIC FIELD ON THE PROPAGATION OF ULTRALONG WAVES AROUND THE EARTH [VLIYANIYE ZEMNOGO MAGNITNOGO POLYA NA RASPROSTRANENIYE SVERKHDLINNYKH VOLN VOKRUG ZEMLI]
R. B. Baybulatov and P. E. Krasnushkin 8 Jun. 1967 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSS'O Ser. Geofiz. (USSR), v. 174, no. 1, 1967 p 84–87
(Contract NAS5-12487)
(NASA-CR-85244; ST-RWP-GM-10620) CFSTI: HC $3.00 CSCL 20N

The influence of the Earth's magnetic field on the propagation of ultralong waves around the Earth is analyzed in the light of a number of preceding works. It is based on the representation of the field of ul waves as approximately the sum of several normal waves. The influence of the field on the propagation of ul waves is then discussed by means of graphs constructed for the three indicated types of waves. Author

N67-30016 Road Research Lab., Harmondsworth (England).
ROAD SURFACE TEXTURE AND THE CHANGE IN SKIDDING RESISTANCE WITH SPEED
Barbara E. Sabey 1966 26 p refs
(RRL-20) CFSTI: $3.00

Past work has indicated that on wet roads the rate of decrease of skidding resistance with speed is largely dependent on the coarseness of the road surface texture. On smooth, fine-grained surfaces the coefficient decreases rapidly with speed, but on coarse-textured surfaces the decrease is much less rapid. Tests have been carried out to examine more closely the way in which coefficients decrease with speed up to 80 mile/h and to attempt to find a quantitative measure of surface texture which will indicate the rate of fall in coefficient with speed. Two techniques of measuring texture have been examined: the sandpatch method from which a measure of texture depth can be obtained, and a new stereophotogrammetric technique which records the surface profile. A statistical correlation has been obtained between the percentage decrease in coefficient between 30 and 80 mile/h and the texture depth, which measures the coarseness of texture. Recommendations for texture-depth requirements for fast roads are given: to restrict the decrease to less than about 25%, a texture depth of more than 0.025 in appears necessary. A better correlation with percentage decrease in coefficient is obtained by a measure of the surface profile (the profile ratio) which takes into account the shape of projections in the surface. Author

N67-30038# Aeronautical Research Council (Gt. Brit.)
AN EXPERIMENTAL INVESTIGATION OF THE REFLECTED-SHOCK PRESSURE-TIME PROFILES FOR AIR, OXYGEN, NITROGEN, ARGON, CARBON DIOXIDE AND ACETYLENE
L. Davies, and D. H. Edwards London, HMSO, 1967 26 p refs Supersedes NPL-AERO-1124; ARC-28040
(ARC-R&M-3446; NPL-AERO-1124; ARC-28040)

A review of the literature on the subject of normal reflection of shock waves at the end of a shock tube is given and indicates that, although many of the phenomena which influence the motion of the reflected shock wave have been identified, the analysis is by no means complete. Experimental reflected-shock pressure-time profiles are described for air, oxygen, argon, nitrogen, carbon dioxide and acetylene for both short duration (≈200 microseconds) and long duration (≈4–10 milliseconds) recording times and the results compared with existing theories (Wood's theory, real gas theory, and Holder and Shultz theory for reflected shock studies in air). For all the gases except nitrogen the initial pressure range was 10–300 mm Hg, the driver gas was room temperature hydrogen and the experiments were carried out in a 2 in. internal diameter shock tube. The reflected-shock pressures were measured using a bar gauge, and a description of a modified bar gauge developed especially for studying the long duration recordings shown in this report is given. The reflected-shock pressure-time profiles for nitrogen were obtained in the N.P.L. 2 in., 3 in. and 6 in. internal diameter shock tubes using hydrogen and helium gases at pressure up to 1800 lb/in^2 abs. In this latter case the shock pressures were measured using S.L.M. PZ.14 transducers. Author

N67-30081 European Organization for Nuclear Research, Geneva (Switzerland).
PHASE-SPACE TRANSFORMATIONS BY MEANS OF QUADRUPOLE MULTIPLETS
E. Regenstreif 20 Mar. 1967 31 p
(CERN-67-6)

The purpose of this paper is to formulate analytic conditions for achieving simple phase-space transformations by means of quadrupole multiplets, particularly triplets, quadruplets, quintuplets and sextuplets. This problem is of importance in synchrotron magnet layouts (e.g. long straight sections), in RF separator design (inter-deflector optics), in beam transport systems, etc. In the first part the general theory is considered. In the second part an attempt is made to cast the transfer matrices of quadrupole multiplets in a relatively simple and usable form. Analytic conditions for achieving simple phase shifts are given in the third part. No use is made of the thin lens approximation; the thick lens approach has been applied throughout. Author

N67-30090 European Organization for Nuclear Research, Geneva (Switzerland).
THE PROGRAM "MARE" FOR THE COMPUTATION OF TWO-DIMENSIONAL STATIC MAGNETIC FIELDS
R. Perin and S. van der Meer 20 Mar. 1967 46 p refs
(CERN-67-7)

Three computer programs are described: magnet relaxation in air (Mare-A), magnet relaxation in iron (Mare-I), and a combination of the two (Mare-C). Mare-A computes the magnetic field distribution in domains of uniform and constant permeability, which may contain currents and whose boundary conditions are given, and accepts any reasonable magnet configuration. Mare-I calculates the flux distribution, the permeability distribution, and the scalar potential on the boundary in two-dimensional saturated magnet cores. The combined program, Mare-C, solves the magnetic field problem completely in both air-coil and iron regions. All three programs were tested by computing several magnets at CERN. The results were in good agreement with the measurements. Descriptions are given of all the programs, and sections are included dealing with data preparation and giving examples of the programs. L.E.W.

N67-30143*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
ON MIXED REFLECTION OF SUNLIGHT

W. H. Heybey 8 Jun. 1967 26 p ref
(NASA-TM-X-53617) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Light falling on an engineering surface will be reflected partly in a preferred direction (specularly), partly in a diffuse manner. The scattering of the light energy is assumed to follow Lambert's cosine rule. The force differential acting on an elemental surface is set up for such cases of mixed reflection. A smoothness coefficient (≤ 1) accounts for that portion of the reflected energy that is radiated specularly. A loss coefficient, also ≤ 1, gives the fraction of the incident energy that enters into the reflected light. Applications are made to the sphere and its motion under the impact of light, and to the circular cone with fully illuminated curved surface, some results being added when a shadow region exists on it. Author

N67-30149*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A VACUUM ULTRAVIOLET SOURCE
Uri Feldman, Marvin Swartz, and Leonard Cohen Jun. 1967 13 p refs
(NASA-TM-X-55823; X-614-67-273) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A low inductance three-electrode spark source for the vacuum ultraviolet fed by a 20 kV, 13 μf capacitor is described. Its main feature is its ability to generate spectra of very high degrees of ionization. A 6 kV spark produces spectra of C V and C VI as well as Fe XVI while a 17–18 kV spark yields Fe XVIII, Al XII, and Al XIII. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-29006*# International Information, Inc., Philadelphia, Pa.
INTERMOLECULAR INTERACTION AND THE EQUATION OF STATE FOR A HIGHLY EXCITED GAS [MEZHMOLEKULYARNOYE VZAIMODEYSTVIYE I URAVNENIYE SOSTOYANIYA VYSOKOVOZBUZHDENNOGO GAZA]
V. N. Mal'nev and S. I. Pekar Washington, NASA, Jun. 1967 15 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 51, no. 6(12), 1966 p 1811–1820
(Contract NASw-1499)
(NASA-TT-F-10936) CSCL 20J

It is shown that the dipole–dipole interaction of two identical molecules existing at different energy levels is inversely proportional to the cube of the distance. It is not nullified during averaging over the entire range of possible orientations of the molecular dipole. This interaction produces a significant contribution to the thermodynamic functions and the equations of state of the excited gas. It may be more significant than the ordinary van der Waals forces and lead to deviation of the gas from the ideal behavior even at small pressures and thus lead to condensation. The process discussed may be significant for the operation of gas lasers. Author

N67-29008*# International Information, Inc., Philadelphia, Pa.
ON THE THEORY OF SURFACE IONIZATION ON RED-HOT METALS [K TEORII POVERKHNOSTNOY IONIZATSII NA RASKALENNYKH METALLAKH]
A. I. Ansel'm Washington, NASA, Jun. 1966 9 p refs Transl. into ENGLISH from Zh. Eksperim. i Teor. Fiz. (Moscow), v. 4, no. 7, 1934 p 678–683
(Contract NASw-1499)
(NASA-TT-F-10978) CSCL 20M

A kinetic theory of surface ionization of alkaline metal atoms is established on the basis of the Sommerfeld model of the metal with a free electron gas. A formula has been obtained for the relative ionization and it agrees up to a factor of 1/2 with an equation found during the thermodynamic study of the effect. Experimental data verify the temperature course of the relationship defined by two formulas, as well as the absolute value provided by an equation derived from the kinetic theory. Author

N67-29063# California Univ., Los Angeles. Dept. of Physics.
POLARIZED PROTON SCATTERING FROM OXYGEN AT 40.0, 37.1, 34.2, 30.4, 27.6, AND 24.2 MeV
Hudson Bluford Eldridge (Ph.D. Thesis) Feb. 1967 111 p refs
(Contract Nonr-233(44))
(P-77; AD-649942) CFSTI: HC $3.00/MF $0.65

The thesis is the first in a series of experiments designed to extend work on the Optical Model description of nucleon-nucleus interactions by measuring the polarization, differential cross section and reaction cross section for the proton-oxygen system at the energies of 24.2, 27.6, 30.4, 34.2, 37.1, and 40.0 MeV. These data are combined into an optical model analysis so as to study both the validity of the model in this energy region as well as a detailed study of the behavior of the parameters in the energy regions about the resonances. TAB

N67-29103# California Inst. of Tech., Pasadena.
^{3}He(^{3}He,T)3p AT 44 MeV
T. A. Tombrello and R. J. Slobodrian (Lawrence Radiation Lab.) Mar. 1967 10 p refs
(Contract Nonr-220(47))
(AD-650970) CFSTI: HC $3.00/MF $0.65

Triton spectra from the reaction 3He(3He,t)3p were measured at a bombarding energy of 44 MeV for laboratory angles between 6 and 25 degrees. These spectra are quite featureless and show no indication of either a 3p final state interaction or of a strong sequential decay mode. Author (TAB)

N67-29204# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
AN APPROACH TO THE BOUND-STATE THREE-BODY PROBLEM WITH APPLICATION TO THE HELIUM-LIKE ATOM
J. R. Jasperse (Ph.D. Thesis—Northeastern Univ.) Mar. 1967 89 p refs *Its* Phys. Sci. Res. Paper No. 317
(AFCRL-67-0165; AD-651912) CFSTI: HC $3.00/MF $0.65

A technique is presented for treating a general type of three-body bound-state problem for situations where the interaction may be written as the sum of three pair potentials. The method is based on the work of Eyges and consists of writing the total wavefunction for the three-body problem in a special form. Some simple one-dimensional applications are examined. The first involves delta-function pair-potentials including an example where one of the pair interactions is repulsive. The second involves the one-dimensional problem of three identical spinless particles interacting through attractive, square-well potentials. The helium atom is discussed from a three-body point of view. Each orbital is expanded into a complete set of two-body Sturmian functions for the Coulomb potential. For states in atomic helium of the form $L=0$ the equations assume a simplified form. For these states, the infinite set of integral equations generated by the expansion is truncated at several orders and solved numerically. Rapid convergence is demonstrated for low-lying states of the helium-like atoms using this method. In particular, results are reported for the 1s1s(1)S, 1s2s(1)S, and 2s2s(1)S states of He, Li(+), and H(-). TAB

N67-29269# Rensselaer Polytechnic Inst., Troy, N. Y.
LINEAR ACCELERATOR PROJECT Annual Technical Report, Jul.–Sep. 1966
Erwin R. Gaerttner [1966] 97 p refs
(Contract AT(30-3)-328)
(RPI-328-71) CFSTI: HC $3.00/MF $0.65

The sensitivity of a neutron-capture detector to prompt neutron scattering was investigated. The capture cross sections of Al, Fe, ^{56}Fe, ^{57}Fe, ^{58}Fe, Ni, ^{58}Ni, ^{60}Ni, ^{61}Ni, ^{64}Ni, and Na were measured at energies from about 10 keV to a few hundred keV. The total neutron cross sections of C, Ta, W, ^{182}W, ^{184}W, and ^{186}W were measured from 0.4 to 20 MeV. Gamma spectra from neutron capture by ^{198}Hg, ^{199}Hg, ^{182}W, and ^{183}W were analyzed; transition strengths were obtained. The average neutron number/fission of ^{238}U was measured over the neutron energy range from 2.5 to 9.0 eV, and the scattering cross sections of ^{239}Pu, ^{233}U, and ^{235}U were measured for neutron energies between 1 and 100 eV. Preliminary transmission measurements of the neutron total cross sections of ^{147}Pm and ^{148}Pm were made over the energy range from 1 eV to 2 keV; a graphical area analysis was performed to obtain parameters for the 15.6 eV ^{147}Pm resonance. Time-dependent neutron spectra were measured in light water, and a computer program was written to analyze the data. A facility for studying low-energy neutron inelastic scattering was investigated, and measurements were made for scattering by polyethylene, NbH, ZrH, and UO_2. Codes were also written to automate data reduction. Transient radiation effects in silicon were investigated using a pulsed 55-MeV electron beam. NSA

N67-29270# Los Alamos Scientific Lab., N. Mex.
FORMATION OF CHARGED π-MESONS IN COLLISIONS BETWEEN 600-MeV NEUTRONS AND PROTONS
V. P. Dzhelepov, V. S. Kiselev, K. O. Oganesyan, and V. B. Flyagin [1966] 33 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 50, Jun. 1966 p 1491–1504
(LA-TR-66-59)

The energy spectra of charged mesons produced in n–p encounters involving 600-MeV neutrons are measured in a broad angular range by means of a multichannel magnetic spectrometer. The spectra are characterized by the presence of a large number of low-energy mesons. The peak of the spectra is at an energy of ≈0.6 from the largest possible value. The angular distributions of $\pi^{\pm}$ mesons in the c.m.s. is described by a formula. The total meson production cross section $\sigma_{np}(\pi^+) = \sigma(\pi_{np}^-) = (1.3 + 0.2) \cdot 10^{-27}$ cm^2. An analysis of the results shows that despite the dominating role of resonance pion production, in phenomenological studies the contribution of nonresonance transitions should be taken into account. Author (NSA)

N67-29271# California Univ., Berkeley. Lawrence Radiation Lab.
SPONTANEOUSLY FISSIONABLE ISOMER WITH HALF-LIFE EQUAL TO 10^{-7} SECONDS
Yu. P. Gangrskii, B. N. Markov, S. M. Polikanov, and Kh. Yungklaussen Nov. 1966 8 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. JINR-P-2841
(UCRL-TRANS-1339) CFSTI: HC $3.00/MF $0.65

A spontaneously fissioning isomer with a half life of 0.8 ± 0.3 × 10^{-7} sec was produced in ^{12}C reactions with ^{238}U. On the basis of the excitation function, the isomeric state was attributed to ^{246}Cf. The cross section for the production of the isomer was determined to be 1.2 ± 0.5 × 10^{-32} cm^2. NSA

N67-29272# Oak Ridge National Lab., Tenn.
THE DECAY OF Re-184 [ISSLEDOVANIE IZLUCHENIYA ^{184}Re]
V. Ageev, Ya. Vrzal, A. Klimenko, Ya. Liptak V. Maidanyuk et al 1966 13 p refs Transl. into ENGLISH of Joint Inst. for Nucl. Res. Rept.-JINR-P-2814
(ORNL-TR-1442) CFSTI: HC $3.00/MF $0.65

Gamma spectra and conversion-electron spectra from the decay of ^{184}Re were measured using a Ge(Li) spectrometer and a magnetic β spectrometer, respectively. Internal–conversion coefficients were determined together with transition multipolarities. NSA

N67-29273# Oak Ridge National Lab., Tenn.
SOLUTION OF SOME PROBLEMS OF MULTIPLE SCATTERING BY THE MONTE CARLO METHOD [SUR LA SOLUTION DE QUELQUES PROBLEMES DE DIFFUSIONS MULTIPLES PAR LA METHODE DE MONTE-CARLO]
Jean-Claude Bluet 1966 55 p refs Transl. into ENGLISH of Comm. a l'Energie Atomique Rept. No. CEA-R-2971
(ORNL-TR-1546) CFSTI: HC $3.00/MF $0.65

Three problems of multiple scattering arising from neutron cross sections experiments, are reported. The common hypotheses are: elastic scattering is the only possible process, angular distributions are isotropic, and losses of particle energy are negligible in successive collisions. In the three cases practical results, corresponding to actual experiments are given. Moreover the results are shown in more general ways, using dimensionless variable such as the ratio of geometrical dimensions to neutron mean free path. The FORTRAN codes are given together with the corresponding flow charts, and lexicons of symbols. The three problems are as listed: (1) Measurement of sodium capture cross section. A sodium sample of given geometry is submitted to a neutron flux. Induced activity is then measured by means of a sodium iodide crystal. The distribution of active nuclei in the sample, and the counter efficiency are calculated by Monte Carlo method taking multiple scattering into account. (2) Absolute measurement of a neutron flux using a glass scintillator. The scintillator is made of lithium-6 loaded glass, and was submitted to neutron flux perpendicular to its plane faces. If the glass thickness e is not negligible compared with scattering mean free path λ, the mean path e' of neutrons in the glass is different from the thickness. Monte Carlo calculations are made to compute this path and a relative correction to efficiency equal to e' − e/e. (3) Study of a neutron collimator. A neutron detector is placed at the bottom of a cylinder surrounded with water. A neutron source is placed on the cylinder axis, in front of the water shield. The number of neutron tracks going directly and indirectly through the water from the source to the detector are counted. Author (NSA)

N67-29280# Oak Ridge National Lab., Tenn.
OPTIMIZATION OF A SHIELD FOR MIXED RADIATION
F. W. Krueger [1966] 4 p refs Transl. into ENGLISH from Kernenergie, (Dresden), v. 9, May 1966 p 165–168
(ORNL-TR-1499)

A plane source of radiation is supposed to emit two kinds of radiation which are shielded by a wall of two materials. The conditions for the maximum efficiency of this shield are given presuming that the mass per unit area or the thickness of the wall is well known. The results are explained by some examples. Author (NSA)

N67-29328# Brown Univ., Providence, R. I. Dept. of Physics.
RADIATION DAMAGE STUDIES IN SOLIDS USING THE TECHNIQUES OF ELECTRON SPIN RESONANCE AND NUCLEAR MAGNETIC RESONANCE Annual Progress Report, 1 May 1966–30 Apr. 1967
P. J. Bray 24 Feb. 1967 65 p refs
(NYO-2024-10) CFSTI: HC $3.00/MF $0.65

ESR studies of lithium borate glasses and polycrystalline compounds γ-irradiated at 77°K led to the postulation of an entirely new spin Hamiltonian for the 5-line spectrum commonly observed in many irradiated boron-containing glasses. By means of a computer program, the experimental spectrum was successfully simulated on the basis of the new Hamiltonian; thus, the proposed model is considered to be verified. ESR studies of lithium borate glasses and compounds doped with divalent manganese supplemented the radiation damage studies described above. Accurate measure of spin-Hamiltonian parameters for Mn^{2+} in the $Li_2O \cdot 4B_2O_3$ compound were made, and it was demonstrated

that the manganese sites in the latter compound are probably similar to some of the sites occurring in the glasses. Extensive efforts were devoted to the study of γ-irradiated niobate and titanate glasses and several new defect centers were identified; among these are Nb^{5+}-e, Nb-O-, Ti^{4+}-e, and Ti-O- centers. Several series of alkali germanate glasses were irradiated under various conditions and examined by ESR techniques. The g values and intensities of the various induced resonances are being studied as functions of glass composition. Attempts are being made to correlate these results with structural changes postulated on the basis of other evidence. Investigations of an interesting class of paramagnetic peroxyborate materials were pursued. Five types of paramagnetic centers traceable to some form of oxygen were identified, including RO· and RO_2· radicals, O_3^-, O_2^-, and O_2 molecules. Here, R is taken to be a four-coordinated boron. The feasibility of using divalent copper as an ESR "probe" of the structure of glasses was demonstrated. A series of $ZnSO_4$–K_2SO_4–$ZnCl_2$–KCl glasses doped with Cu^{2+} are under investigation to determine the possible existence of complex heteroionic compounds in melts of these salts. Author (NSA)

N67-29333# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

CROSS SECTION SENSITIVITY CALCULATIONS FOR SMALL HYDROGEN MODERATED SYSTEMS

S. Weinstein, F. Feiner, K. V. Cooper, and S. I. Armstrong 29 Nov. 1966 45 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6563) CFSTI: HC $3.00/MF $0.65

Effective multiplication constants were calculated for three small hydrogen–moderated solid homogeneous assemblies in the P-3 multigroup approximation using a number of compilations of epithermal microscopic cross section data. These compilations included the evaluated cross section libraries for O, C, Zr, and ^{235}U that were used at the Knolls Atomic Power Laboratory, and for the same elements, a library set modified to accentuate inelastic scattering and anisotropic elastic scattering effects. Author (NSA)

N67-29337# Atomic Energy Establishment, Trombay (India). Nuclear Physics Div.

NUCLEAR DATA ACTIVITIES IN INDIA Progress Report

Aug. 1966 69 p refs

(AEET-267; PR-3) CFSTI: HC $3.00/MF $0.65

Total cross sections for the reaction $^{16}O(n,\alpha)^{13}C$ were obtained from total cross sections for the reactions $^{13}C(\alpha,n)^{16}O$; ^{17}O level widths were also determined. The angular and energy distributions of fission fragments from the neutron fission of ^{235}U were measured, as were neutron resonance parameters for ^{197}Au, ^{165}Ho, ^{109}Ag, and ^{181}Ta. Isomeric cross-section ratios for (n,γ) reactions on ^{77}Ge and ^{82}Se were measured using a radiochemical method; and neutron total cross sections, scattering cross sections, and scattering angular distributions were calculated for the energy range 0.1 to 4.0 MeV using the optical and statistical models. The reactions $^{51}V(p,\alpha)$ and $^{51}V(p,n)$ were also investigated, together with proton elastic and inelastic scattering by ^{51}V. The spins of levels in ^{25}Mg and ^{27}Mg were obtained from p–γ angular correlation measurements on the reactions $^{24}Mg(d,p\gamma)^{25}Mg$ and $^{26}Mg(d,p\gamma)^{27}Mg$. Excitation functions for alpha elastic scattering by ^{6}Li and ^{24}Mg were measured; resonances corresponding to levels in ^{10}B and ^{28}Si were observed. The differential cross section for the reaction $^{40}Ca(He\text{-}3,p)^{42}Sc$ was calculated, and the life-times of the 1.10- and 1.29-MeV states of ^{59}Co were measured. The intensity of the 1.114-MeV γ transition in the decay of ^{65}Zn was measured; and experimental values of the thermalization and diffusion parameters of Pb were obtained, while similar parameters were calculated for BeO. Cold neutron scattering by liquid CD_4 and CH_4 was investigated, together with lattice vibrations of V and the phonon spectrum of Mg. A neutron diffraction spectrometer was set up, and computer programs were written for neutron diffraction calculations. Excitation functions and n–γ angular correlations for the reaction $^{51}V(p,n)^{51}Cr$ were measured, as were the cross sections for some neutron reactions on Ca isotopes at 14 MeV. Cross sections for the reactions $^{45}Sc(n,2n)^{44m,g}Sc$ were also measured. The decay of ^{147}Nd was investigated; spin-parity assignments were made to levels in ^{147}Pm. Angular distributions from the reaction $^{14}N(n,\alpha)^{11}B$ to low-lying levels of ^{11}B were measured; the distributions were fitted in terms of a heavy-particle stripping mechanism. A decay scheme for ^{78}Ga was proposed on the basis of β–γ and γ–γ coincidence measurements. The $^{174}Yb(n,p)^{174}Tm$ cross section was measured at 14.8 MeV, and the decay of ^{174}Tm was investigated. Equipment for β–γ angular correlation measurements was also developed. Absolute cross sections for (n,2n) reactions on ^{63}Cu, ^{19}F, ^{69}Ga, ^{107}Ag, and ^{64}Zn were measured, as were (n,α) and (n,p) cross sections for 14-MeV neutrons on some Z = 8 to 25 nuclei. Polarization effects in Compton and Rayleigh scattering were also investigated, and the matrix elements for some transitions in ^{111}Ag and ^{160}Tb were studied. Internal bremsstrahlung spectra from ^{210}Bi, ^{51}Cr, ^{31}P, ^{204}Tl, and ^{91}Y were measured, and the decay schemes of ^{99}Mo and ^{97}Zr were investigated. NSA

N67-29389# Texas A&M Univ., College Station. Activation Analysis Research Lab.

INVESTIGATIONS IN AUTOMATED ACTIVATION ANALYSIS

Oak Ridge, Tenn., AEC, 31 Aug. 1966 175 p refs

(Contract AT(40-1)-2671-1)

(TEES-2671-5) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. INTRODUCTION M. P. Menon p 1–4 refs (See N67-29390 16-24)

2. PROGRESS OF RESEARCH IN ELECTRONICS AND EQUIPMENT DESIGN L. E. Fite and H. T. Russell p 5–22 refs (See N67-29391 16-14)

3. SAMPLE PREPARATION TECHNIQUES J. S. Hislop, J. Cuypers, and A. Rainosek p 23–38 ref (See N67-29392 16-06)

4. PUBLIC BENEFIT DEMONSTRATIONS USING THE TEXAS A&M UNIVERSITY AUTOMATION ACTIVATION ANALYSIS SYSTEMS M. P. Menon p 39–68 refs (See N67-29393 16-24)

5. TWO-DIMENSIONAL NUCLEAR ACTIVATION ANALYSIS M. P. Menon, H. T. Russell, and A. P. Rainosek p 69–70 refs (See N67-29394 16-24)

6. POTENTIALITIES OF AN 88 INCH VARIABLE ENERGY CYCLOTRON FOR CHARGED PARTICLE ACTIVATION ANALYSIS M. Y. Cuypers p 81–96 refs (See N67-29395 16-11)

7. OTHER APPLIED AND BASIC NUCLEAR RESEARCH M. Cuypers, J. S. Hislop, G. A. Lorenzen, and M. P. Menon p 97–128 refs (See N67-29396 16-24)

8. COMPUTERIZED DATA REDUCTION METHODS FOR USE IN ACTIVATION ANALYSIS D. F. Berry and M. P. Menon p 129–157 refs (See N67-29397 16-24)

N67-29390# Texas A&M Univ., College Station.

INTRODUCTION

M. P. Menon *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 1–4 refs (See N67-29389 16-24)

Presented are introductory remarks which summarize reported developments in the field of nuclear activation analysis. S.C.W.

N67-29393# Texas A&M Univ., College Station.

PUBLIC BENEFIT DEMONSTRATIONS USING THE TEXAS A&M UNIVERSITY AUTOMATION ACTIVATION ANALYSIS SYSTEMS

M. P. Menon *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 39–68 refs (See N67-29389 16-24)

Research concerned with the application of activation analysis techniques to problems involving public benefit and interest is reported. Described are analytical studies involving the use of various facilities at Texas A&M University which were performed for the

U.S. Department of Agriculture at Gulfport, Mississippi and the University of Texas Medical Branch at Galveston, Texas. USDA studies focused on presticide residue analyses for a large number of samples, while the University of Texas Medical Branch required the analysis of a limited number of placenta samples for trace elements. Experiments cited include a feasibility study of the use of automated systems for a large scale analysis of bromine and mercury pesticide residues; measurements of bromine in USDA hay samples; analyses of USDA foliage, fruit, and vegetable samples for bromine, arsenic, and mercury; and activation analysis of trace elements and K/Na ratios in placenta samples. S.C.W.

N67-29394# Texas A&M Univ., College Station.
TWO-DIMENSIONAL NUCLEAR ACTIVATION ANALYSIS
M. P. Menon, H. T. Russell, and A. P. Rainosek *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 69–70 refs (See N67-29389 16-24)

Neutron activation and scanning techniques were employed to study the localization of impurities in an aluminum foil which was irradiated in a reactor in a given plane where the spatial distribution of the neutron flux was known. After sufficient cooling, the entire aluminum foil was scanned using a CsI–NaI(T1) detector to measure at different locations, the activity characteristic of the impurity. The spatial distribution of the impurities in the foil was then determined using a prescribed equation. Experimental measurements included determinations of thermal neutron flux distribution in a plane near the reactor core; the fractional side contribution to the localized counting; and scanning measurements on the activated aluminum foil. Although results of measurements are regarded as semi-quantitative, it is shown that neutron activation coupled with scanning techniques for the localization of impurities in foils can be improved by a judicious choice of mathematical model and various correction factors for the relative activity measurements. S.C.W.

N67-29396# Texas A&M Univ., College Station.
OTHER APPLIED AND BASIC NUCLEAR RESEARCH
M. Cuypers, J. S. Hislop, G. A. Lorenzen, and M. P. Menon *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 97–128 refs (See N67-29389 16-24)

Summarized is research performed in the areas of basic and applied nuclear research. Cited are studies of sensitivities for 14 MeV neutron activation analysis which were conducted to experimentally determine detection limits for the elements, using 14 MeV neutron activation techniques under specified conditions; progress in perfecting the analytical techniques for a remote activation analysis of the lunar surface; 14.5 MeV neutron activation cross sections for some of the rare earth nuclides; the applicability of an atomic absorption/flame spectrometer as an alternate analytical tool in activation analysis; and measurements of the ranges and kinetic energies of fragments from 14.5 MeV neutron induced fission of ^{238}U. S.C.W.

N67-29397# Texas A&M Univ., College Station.
COMPUTERIZED DATA REDUCTION METHODS FOR USE IN ACTIVATION ANALYSIS
D. F. Berry and M. P. Menon *In its* Invest. in Automated Activation Anal. 31 Aug. 1966 p 129–157 refs (See N67-29389 16-24)

Described are two different computer programs which were developed to measure the gamma activity of the individual radioisotopes contributing to a composite gamma ray spectrum of an activated sample. The first of these, the partial peak area method, will compute the activity under a photo-peak within a given range after the subtraction of the background using the base-line method. The program is designed to process data in the form of punched cards from the Mark III system. The second program involves the use of the spectrum stripping technique with provision for proper weighting, spectrum smoothing, and gain drifts. In the second program, the total gamma activity of the individual isotope may be determined rather than measuring only the peak area activity. In addition, the energy spectrum of an impurity, including the bremsstrahlung, unobservable in the original spectrum is also revealed. When the correct activity due to the product isotope of an element is measured, it can be easily compared with that of the standard to compute the mass. The program is coded in Fortran IV for an IBM 7094 computer and is designed for use with punched cards in the Mark III format. S.C.W.

N67-29403# Hawaii Univ., Honolulu.
MULTILEVEL ATOM RADIATIVE TRANSFER PROBLEMS Technical Report, 1 Jan. 1965–31 May 1966
John T. Jefferies and Gerard D. Finn Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1967 85 p refs
(Contract AF 29(601)-6707)
(AFWL-TR-66-131; AD-650631) CFSTI: HC $3.00/MF $0.65

The report contains results of some investigations on line transfer problems in multi-level atoms. A discussion is presented of the formulation and methods of solution of the two-level problem. This procedure is generalized to a special case of the three-level atom and, on this basis. A discussion is given of the question of the equality of the depth dependence of source functions in multiplet lines. A discussion of the analogous problem for a four level atom is given. The solution of the transfer equation in the free bound continuum of an atom is considered, and some inherent difficulties in this problem are examined. A discussion is given of the transfer problem related to those found in the case of free bound continuum transfer. In section VII consideration is given to the question of the degree of frequency coherence to be expected in a scattering process which is completely non-coherent in the frame of the atom. Finally an examination is made of the approximations used in the numerical procedures devised for solution of the transfer equation. TAB

N67-29440 Tokyo Univ. of Education (Japan). Dept. of Physics.
NUCLEAR DEMOCRACY AND THE HIGH ENERGY SCATTERING OF A COMPOSITE PARTICLE
Tetsuo Sawada [1967] 7 p refs
(TUEP-67-11)

It is postulated that every elastic scattering has the same type of high energy behavior, and the types of high energy behavior which are consistent with this postulate are examined. The Regge singularities dominating the high energy behavior are determined, such that the scattering $a + b \rightarrow a + b$ and $'aa' + b \rightarrow 'aa' + b$ have the same type of high energy behavior. It is shown that the Regge dipole may be a Regge trajectory compatible with the nuclear democracy. N.E.N.

N67-29448# Maryland Univ., College Park. Dept. of Physics and Astronomy.
MAGNETIC SUSCEPTIBILITY FOR ANDERSON'S MODEL OF A DILUTE ALLOY
David S. Falk Aug. 1966 9 p refs
(Grant AF-AFOSR-735-65)
(TR-606; AD-649925) CFSTI: HC $3.00/MF $0.65

It is shown that the Kondo logarithmic terms first appear in the fourth order of the magnetic susceptibility of the Anderson model for a localized moment, when the susceptibility is expanded in powers of the s-d coupling, even when the contributions from poles at the (broadened) d levels are considered. Author (TAB)

N67-29487# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
QUANTUM THEORY AND FUNDAMENTAL INTERACTIONS
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 63–78 refs (See N67-29462 16-08)

Particular emphasis is placed on many-body interactions in fluids, in magnetism and in superconductivity. Also included are studies of perturbation theory, transition probabilities, and molecular orbitals. Author

N67-29509# Instituto de Investigacion Aeronautica y Espacial, Buenos Aires (Argentina). Laboratorio de Radiaciones.
DETERMINATION OF CONVERSION COEFFICIENTS IN THE DECAY OF Ba^{133} BY MEANS OF SEMICONDUCTOR COUNTERS
H. E. Bosch, E. Szichman, A. Baseggio, and R. Dolinkue Dec. 1966 19 p refs
(Contract DA-ARO-49-092-66-G121)
(LR-11; AD-649902) CFSTI: HC $3.00/MF $0.65

The K-conversion coefficients corresponding to four transitions in Ca133 were determined applying the electron-gamma coincidence method. The gamma-rays have been detected with conventional scintillation counters. A special electron-gamma coincidence spectrometer was constructed by using, as electron detector, a lithium-drifted semiconductor counter operated into a vacuum chamber at low temperature. An analysis of electron-conversion spectra were performed by studying the line shapes of standard single lines as a function of the energy. The following values were obtained: alpha-K (0.081) = 1.34 plus or minus 0.09, (K/LM = 5.4 plus or minus 0.5); alpha-K (0.277) = 0.054 plus or minus 0.010, (K/LM = 5.5 plus or minus 1.5); alpha-K (0.305) = 0.037 plus or minus 0.003; and alpha-K (0.356) = 0.023 plus or minus 0.002, (K/LM = 5.0 plus or minus 0.5). As a by-product the conversion coefficient for the 0.376-MeV transition was determined by analysis of the single electron and gamma-ray spectra, its value being alpha-K (0.387) = 0.028 plus or minus 0.010, K/LM-5 plus or minus 1. Author (TAB)

N67-29556# Illinois Univ., Urbana. Dept. of Physics.
VIOLATION OF CP INVARIANCE AND NON-LEPTONIC DECAYS
K. Nishijima and L. J. Swank [1967] 13 p refs
(Contract N00014-67-A-0305-0005; Grant NSF GP-6198)
(AD-650951) CFSTI: HC $3.00/MF $0.65

Since the experimental discovery of the decay mode neutral-K(L) to positive-pion + -negative-pion, a number of theoretical propositions, have been made. A new scheme is proposed for non-leptonic decays on the basis of the assumption that both CP-conserving and violating non-leptonic decays should be ascribed to the same primary interaction. TAB

N67-29620# Defense Research Corp., Santa Barbara, Calif.
THEORY OF DISSOCIATIVE ATTACHMENT
T. F. O'Malley Feb. 1966 64 p refs
(Contract DA-49-083-OSA-3132; ARPA Order 367)
(TM-344; AD-649782) CFSTI: HC $3.00/MF $0.65

A fairly comprehensive theoretical treatment of the dissociative attachment (DA) of electrons to diatomic molecules (AB + e yields A(-) + B) is given, going from general formalism to explicit cross section formulas and comparison with experimental results. Author (TAB)

N67-29624# Michigan Univ., Ann Arbor. Dept. of Physics.
POLARIZATION PARAMETER IN ELASTIC PROTON–PROTON SCATTERING FROM 0.75 TO 2.84 GeV
Homer A. Neal and Michael J. Longo Mar. 1967 52 p refs
(Contract Nonr-1224(23))
(TR-27; Rept.-03106-27-T; AD-650156) CFSTI: HC $3.00/MF $0.65

The polarization parameter in elastic proton–proton scattering was measured at 0.75, 1.03, 1.32, 1.63, 2.24, and 2.84 GeV by employing a double-scattering technique. An external proton beam from the Brookhaven Cosmotron was focused on a three-inch long liquid hydrogen target and the elastic recoil and scattered protons were detected in coincidence by scintillation counters. The polarization of the recoil beam was determined from the azimuthal asymmetry exhibited in its scattering from a carbon target. Values of the polarization parameter as a function of the center-of-mass scattering angle are given for each incident beam energy. The predictions of the Regge theory for polarization in elastic proton–proton scattering and recently published phase shift solutions are compared with the experimental results. Surprisingly good agreement with the Regge predictions is found despite the low energies involved. Author (TAB)

N67-29633# California Univ., La Jolla. Dept. of Physics.
ELECTRONIC STRUCTURE FROM THE STANDPOINT OF THE INHOMOGENEOUS ELECTRON GAS
Walter Kohn 1 Mar. 1967 15 p refs
(Contract Nonr-2216(11))
(TR-44; AD-649938) CFSTI: HC $3.00/MF $0.65

A new theory of electronic structure, developed recently by Hohenberg, Kohn, Sham and Tong is briefly outlined. This theory was used to make a parameter-free calculation of metallic Na, without use of semi-empirical ionic potentials or of scattering phase shifts derived from atomic spectra. The results for the lattice parameter and bulk modulus are about as accurate as those obtained by earlier, semi-empirical methods. It is hoped that this method will also be useful for the calculation of mechanical and thermodynamic properties of other metals and alloys. Author (TAB)

N67-29644# California Univ., San Diego. Dept. of Physics.
ABSENCE OF LONG-RANGE OVERHAUSER SPIN-DENSITY WAVES IN ONE OR TWO DIMENSIONS
David C. Hamilton 31 Jan. 1967 10 p refs
(Contract Nonr-2216(11))
(TR-43; AD-649963) CFSTI: HC $3.00/MF $0.65

If an Overhauser static spin-density wave is present in an electron gas, the Fourier transform of a certain spin-density correlation function is at least as singular as $1/(q-Q)$ sq. near the wave number Q of the spin-density wave. This rules out long-range spin-density waves in one and two dimensions at finite temperature, since it must be possible to Fourier-transform this correlation function back to position space. Author (TAB)

N67-29648# Oslo Univ., Blindern (Norway). Inst. for Theoretical Physics.
LIST AND ABSTRACTS OF SCIENTIFIC REPORTS GIVEN IN THE GRANT PERIOD FEBRUARY 2, 1966–FEBRUARY 28, 1967
John Midtdal 28 Feb. 1967 7 p refs
(Grant AF-EOAR-66-33)
(AFOSR-67-0899; AD-651117) CFSTI: HC $3.00/MF $0.65

Theoretical and numerical investigations for closed states of two-electron atoms and ions, with perturbation theory expansions of their wave functions, non-relativistic energies and various corrections. Numerical calculations of the energy of some quasi-discrete and autoionizing states for He and H(-), using the scaling-variation orthogonalization procedure. Author (TAB)

N67-29667# Naval Civil Engineering Lab., Port Hueneme, Calif.
EFFICIENCY OF TWO ESTIMATORS FOR A POISSON DISTRIBUTION
W. L. Wilcoxson and M. L. Eaton Apr. 1967 20 p refs
(TR-519; AD-649910) CFSTI: HC $3.00/MF $0.65

A given Poisson phenomenon is characterized by a single parameter. From observed records this parameter may be estimated in at least two ways, namely by the mean and variance estimates from the sample, each computed from the observations. The efficiency of the variance estimate (as compared with the mean estimate) decays rapidly as the value of the parameter increases, and increases slowly with increasing sample sizes. TAB

N67-29678# Massachusetts Inst. of Tech., Cambridge.
STUDY OF THERMAL NEUTRON CAPTURE GAMMA RAYS USING A LITHIUM-DRIFTED GERMANIUM SPECTROMETER Interim Report

Victor John Orphan and Norman C. Rasmussen Jan. 1967 206 p refs
(Contract AF 19(628)-5551)
(MITNE-80; SR-1; AFCRL-67-0104; AD-649805) CFSTI: HC $3.00/MF $0.65

A gamma-ray spectrometer, using a 30 cc coaxial ge(li) detector, which can be operated as a pair spectrometer at high energies and in the compton suppression mode at low energies provides an effective means of obtaining thermal neutron capture gamma spectra over nearly the entire capture gamma energy range. The energy resolution (FWHM) of the spectrometer is approximately 0.5% at 1 MeV and 0.1% at 7 MeV. Capture gamma-ray energies can be determined to an accuracy of about 1 KeV. The relatively high efficiency of this spectrometer allows the use of an external neutron beam geometry, which simplifies sample changing. Using a 4096 channel pulse height analyzer, the capture gamma spectrum of an element may be obtained in about one day. Low cross section (order of 0.1 B) elements with many weak intensity gammas may be studied. Over 100 gamma rays have been identified in the spectrum of one such element, Zr. The spectra of Be, Sc, Fe, Ge, and Zr are presented. Author (TAB)

N67-29684# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
THE DEPENDENCE OF THE CALCULATED ELASTIC CONSTANTS OF THE C/A RATIO FOR HEXAGONAL CLOSE-PACKED STRUCTURE METALS
A. Czachor and A. Pindor Nov. 1966 16 p refs
(INR-762/II/PS) CFSTI: HC $3.00/MF $0.65

The elastic constants for metals of hexagonal, close-packed structure were calculated, assuming coulomb-screened interaction and Born–Mayer interaction between ions. It was found, that the interactions are large enough to lead to instability of the hexagonal, close-packed structure for the ratio of lattice parameters (c/a). Author (NSA)

N67-29685# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INELASTIC np-INTERACTIONS AT 2 TO 10 GeV II: METHODS FOR SEPARATION OF THE REACTION CHANNELS [NEUPRUGIE np VZAIMODEISTVIYA PRI ENERGII OT 2 DO 10 GeV. II: METODY RAZDELENIYA KANALOV REAKTSII]
V. I. Moroz, A. V. Nikitin, A. I. Rodionov, and Yu. A. Troyan 1967 17 p refs In RUSSIAN
(JINR-P1-3145) CFSTI: HC $3.00/MF $0.65

The methods of separation of the reaction channels of np-interactions in three- and five-prong stars, produced by bombarding a 24-liter bubble chamber with 2–10 GeV neutrons, are considered. For this separation the x^2 method was applied as well as the investigations of an extreme kinematics using some considerations on probability of realization of effective masses of secondaries. As a result a sufficiently well-defined separation of the reaction channels is obtained for the given neutron bombardment. The methods proposed allow one to estimate the most probable neutron momentum, which induced the given interaction. Author (NSA)

N67-29686# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
COMPARISON OF THE DISPERSION SUM RULES WITH THE EQUAL-TIME COMMUTATOR SUM RULES
V. G. Pisarenko 1967 25 p refs
(JINR-E2-3119) CFSTI: HC $3.00/MF $0.65

The sum rules obtained from the one-dimensional dispersion relations are compared with the sum rules deduced in the Fubini technique from the equal-time commutator relations for photoproduction problem. In the resonance model the results are the same from these treatments and are compared with experiment. The obtained sum rules for a group of the invariant amplitudes are in agreement with experiment while these for another group are not. Author (NSA)

N67-29687# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
TEST OF DEFLECTOR FOR HIGH ENERGY PARTICLE ELECTRODYNAMIC SEPARATOR [ISPYTANIE OTKLONYAYUSHCHEGO USTROISTVA ELEKTRODINAMICHESKOGO SEPARATORA CHASTITS VYSOKIKH ENERGII]
S. V. Mukhin, V. A. Popov, S. V. Rikhvitskii, and I. N. Semenyushkin 1967 11 p refs In RUSSIAN
(JINR-P9-3165) CFSTI: HC $3.00/MF $0.65

The results of tests of the deflector for the high energy particle electrodynamic separator with π-meson beam are reported. For the chosen geometry of the separator the maximum deflection of the 4.95 GeV/c particles is equal to $\Delta\alpha = \pm 2.8$ mrad at hf power of 1.5 MW(e), the electric field intensity being 22 kV/cm. Author (NSA)

N67-29688# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
IDEAS ON NEW EXPERIMENTS ON POLARIZED TARGETS [NOVYE EKSPERIMENTY NA POLYARIZOVANNYKH MISHENYAKH]
L. I. Lapidus 1967 17 p refs In RUSSIAN; ENGLISH summary
(JINR-P2-3217) CFSTI: HC $3.00/MF $0.65

A possible application of polarized proton targets and polarized proton and antiproton beams to the direct testing of T,P,C invariance and the CPT-theorem is considered. It is pointed out that the account of N–N and $\bar{N}$–N scattering bremsstrahlung causes deviation from the equation P=A. A part of bremsstrahlung whose spectrum is proportional to $d\omega/\omega$ does not affect the relation P=A, the deviation from which begins from the $\sim d\omega$ spectrum part. The result of A. V. Tarasov's consideration is given. The P-invariance can be tested both in the up–down asymmetry measurement and in the total cross section measurements using the polarized beam and the polarized target. Also, as has been noted previously, the study of polarization effects provides a possibility for testing C,P,T and CPT-invariances. If there is no P-parity violation, the measurement of $\sigma_{P_1P_2}$ is of interest for testing higher isotopic symmetries. It is noted that the direct determination of forward scattering amplitudes is simplified when measuring $\sigma_{P_1P_2}$. NSA

N67-29689# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
HYPOTHESIS OF ADDITIVITY AND HADRON MASS FORMULA [GIPOTEZA ADDITIVNOSTI I MASSOVYE FORMULY DLYA ADRONOV]
A. A. Slavnov 1967 7 p refs In RUSSIAN
(JINR-P2-3170) CFSTI: HC $3.00/MF $0.65

Mass formulas which describe the unitary multiplet splitting are obtained on the basis of additivity hypotheses for the hadron scattering amplitude. No assumptions are made on transformation properties of the SU_3-breaking symmetry interaction. Author (NSA)

N67-29690# Joint Inst. for Nuclear Physics, Dubna (USSR). Lab. of High Energy.
INCOHERENT SCATTERING OF SLOW NEUTRONS IN POLARIZED TARGET [NEKOGERENTNOE RASSEYANIE MEDLENNYKH NEITRONOV V POLYARIZOVANNOI MISHENI]
V. G. Baryshevskii, V. L. Lyuboshits, and M. I. Podgoretskii 1967 8 p refs In RUSSIAN
(JINR-P4-3158) CFSTI: HC $3.00/MF $0.65

Transmission of polarized slow neutrons through a polarized crystal target is considered. It is shown that incoherent neutron scattering in such a model is due not only to the scattering with spin flip but also to the presence of fluctuations of a magnetic quantum nucleus number. The relative deposit of these processes depends on the angles between the direction of neutron polarization and that characterizing the polarization target state. Author (NSA)

N67-29691# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

INVESTIGATION OF (e^+e^-) PAIR PRODUCTION BY ELECTRONS WITH ENERGY OF 2.4 GeV [ISSLEDOVANIE OBRAZOVANIYA (e^+e^-)-PAR ELEKTRONAMI S ENERGIEI 2.4 GeV]

Ya. Bem, V. G. Grishin, M. M. Muminov, and V. D. Ryabtsov 1967 26 p refs In RUSSIAN

(JINR-P1-3143) CFSTI: HC $3.00/MF $0.65

Direct production of (e^+e^-)-pairs with E $\gamma \geq 10$ MeV by 1.25-4 GeV electrons was investigated with the help of a 24-liter propane bubble chamber. The obtained cross section $\sigma_{1\gamma} = 55 \pm 24$ mb is in agreement with the theoretical value obtained by Bhabha. The method proposed admits a successful measuring of the $\sigma_{1\gamma}$ by means of a hydrogen bubble chamber. Author (NSA)

N67-29692# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

EFFECTIVE MASS SPECTRUM IN ARBITRARY CASCADES [SPEKTR EFFEKTIVNYKH MASS V PROIZVOL'NYKH KASKADAKH]

G. I. Kopylov 1967 29 p refs In RUSSIAN

(JINR-P2-3162) CFSTI: HC $3.00/MF $0.65

A recipe is formulated which allows the expression in quadratures of the distribution of the effective mass of any group of particles produced in an arbitrary cascade. Author (NSA)

N67-29693# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.

A SEARCH FOR RESONANCES IN DIBARYONIC SYSTEM WITH S = −1 AND S = 0 [POISK REZONANSOV V SISTEME DVUKH BARIONOV SS = −1 IS = 0]

V. F. Vishnevskii, V. I. Moroz, and B. A. Shakhbazyan 1967 7 p refs In RUSSIAN

(JINR-P1-3169) CFSTI: HC $3.00/MF $0.65

Preliminary results on effective mass spectrum of the ΛP system are given. The experiment was performed with the propane bubble chamber exposed to neutrons with momenta up to 11 GeV/c. Peaks at mass values of 2062, 2220, and 2573 MeV were found. Author (NSA)

N67-29694# Joint Inst. for Nuclear Research, Dubna (USSR).

MEASUREMENT OF THE R PARAMETER AND THE PHASE-SHIFT ANALYSIS OF PP-SCATTERING AT 600 MeV [IZMERENIE PARAMETRA R I FAZOVYI ANALIZ P-P RASSEYANIYA PRI 600 MeV]

B. M. Golovin, R. Ya. Zul'karneev, V. S. Kiselev, S. V. Medved, V. I. Nikanorov et al 1967 10 p refs In RUSSIAN

(JINR-P1-3167) CFSTI: HC $3.00/MF $0.65

The triple scattering parameter R was measured in the scattering of 605-MeV protons on protons with spark chambers controlled by scintillation counters. The phase-shift analysis of experimental data was performed at ≈600 MeV. Author (NSA)

N67-29696# Paris Univ., Orsay (France).

ELECTRON SCATTERING FROM ^{9}Be

M. Bernheim, T. Stovall, and D. Vinciguerra Jan. 1967 43 p refs

(LAL-1165) CFSTI: HC $3.00/MF $0.65

Form factors for electron elastic and inelastic scattering by ^{9}Be at 340 MeV were measured. The results were analyzed using several nuclear models. Values for the nuclear charge radius and quadrupole moment of ^{9}Be were obtained. NSA

N67-29704# Texas Univ., Austin.

ISOBARIC ANALOGUE RESONANCES IN ELASTIC AND INELASTIC SCATTERING OF PROTONS ON Pb-208

Leslie Parish, S. A. A. Zaidi, P. Von Brentano, and C. Fred Moore Sep. 1966 65 p refs

(Contract AT(40-1)-2972)

(ORO-2972-7; TR-1) CFSTI: HC $3.00/MF $0.65

Isobaric analog resonances were observed in excitation curves for elastic and inelastic proton scattering on ^{208}Pb. The resonances were identified with the single-particle states in ^{209}Pb. The elastic scattering excitation functions were analyzed using a single level plus optical and Coulomb potential formula. Widths for the isobaric analog states were determined to be of the order of 300 keV. NSA

N67-29709# Brookhaven National Lab., Upton, N. Y.

THREE DIMENSIONAL PROPERTIES OF MAGNETIC BEAM TRANSPORT ELEMENTS

G. T. Danby, S. T. Lin, and J. W. Jackson [1967] 9 p refs Presented at Natl. Particle Accelerator Conf., Washington

(Contract AT(30-2)-GEN-16)

(BNL-11142; COO-670307-16) CFSTI: HC $3.00/MF $0.65

Analytical and experimental methods to describe precisely, in three dimensions, the magnetic fields of beam transport elements are discussed. The influence of the fringing field on beam optical properties and magnet design are presented. With appropriate boundary conditions the field components are expressed in terms of the magnetic potential to arbitrarily high orders with empirical coefficients and are grouped in a form to avoid the divergence of higher order terms. As an accurate description of the true field is obtained, a very precise trajectory can be computed for a known momentum. In addition, the more useful inverse problem of finding the momentum of a particle with known input and output trajectory coordinates is attacked. The trajectory solution is expressed as the sum of an analytical part plus perturbation terms. The first order solution for the momentum is easily obtained and the convergence of the subsequent perturbation calculations is very rapid even for extreme rays. The value of this method, with its precise treatment of fringing fields, is emphasized by treating in detail a wide angle spectrometer (120-in. wide, 36-in. long, 24-in. gap). The perturbation technique shows promise that an accurate instantaneous read-out of the momentum can be obtained by employing a modest number of perturbation corrections stored in the memory of the computer. Author (NSA)

N67-29710# Brookhaven National Lab., Upton, N. Y.

NUCLEAR STRUCTURE PHYSICS USING 1-GeV PROTONS

J. L. Friedes 6 Feb. 1967 33 p Presented at Ann. Meeting of the Am. Phys. Soc., New York, 30 Jan. 1967

(Contract AT(30-2)-GEN-16)

(BNL-11035; CONF-670109-1) CFSTI: HC $3.00/MF $0.65

Details of the experimental apparatus and some results of preliminary measurements are given for nuclear physics experiments using 1-GeV protons from the Brookhaven Cosmotron. Descriptions are given of the spectrometers; the beam transport system; the target and target stand; and the wire spark chamber system. Preliminary results are given on elastic scattering of 1-GeV protons from H and ^{16}O, and for scattering of 2-GeV protons from D. NSA

N67-29716# Academy of Sciences (USSR), Moscow. Siberian Div.

INTERACTIONS OF COHERENT BETATRON OSCILLATIONS WITH EXTERNAL SYSTEMS

N. S. Dikanskii, M. M. Karliner, A. N. Skrinskii, V. E. Shapiro, and I. A. Shekhtman [1966] 11 p refs Transl. into ENGLISH from the Russian Presented at Intern. Symp. on Electron and Positron Storage Rings, Saclay, France, 26–30 Sep. 1966

(CONF-660939-7) CFSTI: HC $3.00/MF $0.65

It was discovered that in storage ring VEPP-2, accelerated damping of betatron oscillations cannot be explained by the finite conductivity of the chamber walls. In connection with this, the interaction of the beam with various types of parasitic dissipative systems is investigated. It is shown that for a given frequency of betatron oscillations it is possible to have accelerated damping as well as self-excited coherent oscillations depending on the resistance of the interacting element for combination frequencies. The obtained decrements and increments can considerably exceed the values caused by the finite conductivity of the chamber walls. Author (NSA)

N67-29720# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

ON THE THEORY OF PHOTO- AND ELECTROPRODUCTION OF THE N*(1236)

F. Gutbrod and D. Simon Jan. 1967 38 p refs

(DESY-67/1)

Multiple dispersion relations and the Fredholm determinantal method are applied to the calculation of the transverse part of the γNN^* vertex, using relativistic kinematics. The unphysical cuts of the multipole amplitudes were approximated by the second-order and fourth-order (box) diagrams containing nucleon and pion exchange. No cut-off is necessary. The results for the magnetic dipole amplitude agree, within the theoretical errors, with those of the static thoery, while the electric quadrupole turns out to be resonant too. The behavior of the transition amplitudes for large momentum transfer is discussed. Author (NSA)

N67-29726# Iowa State Univ. of Science and Technology, Ames.

SU^3 PARTICLE-HOLE STATES IN ^{40}Ca

Donald Larner and S. A. Williams Dec. 1966 101 p refs

(Contract W-7405-ENG-82)

(IS-1420) CFSTI: HC $3.00/MF $0.65

The contributions of the one-particle, one-hole excitations to the negative-parity levels of ^{40}Ca are calculated. The basis states are harmonic oscillator states symmetrized according to SU_3; and in the process of constructing these states, some Clebsch–Gordan coefficients for the (30) representation are computed. The residual interaction employed is the Kallio–Kolltveit potential, which uses the Moszkowski–Scott separation method. The energy matrix is computed directly from the SU_3 states, using the projection integral method of Elliott. Nine states are obtained, seven of which may be compared with experimental data on the low-lying states of ^{40}Ca. Five of these seven states show very good agreement with experiment. Author (NSA)

N67-29739# Deutsches Elektronen-Synchrotron, Hamburg (West Germany).

π^+ PHOTOPRODUCTION BETWEEN 1.2 AND 3 GeV AT VERY SMALL ANGLES

G. Buschhorn, J. Carroll, R. D. Eandi, P. Heide, R. Huebner et al Feb. 1967 9 p refs

(DESY-67/3)

The reaction $\gamma p \rightarrow \pi^+ n$ was investigated for photon energies between 1.2 and 3 GeV and pion cm angles from 2.5 to 15°. The cross section is strongly peaked in the forward direction and shows resonance structure in the region of the $N^*_{3/2}$ (1920) and $N^*_{1/2}$ (2190). Author (NSA)

N67-29740# Deutsches Elektronen-Synchrotron, Hamburg. (West Germany).

DERIVATION OF SUM RULES FOR THE ISOVECTOR NUCLEON FORM FACTOR FROM A DIVERGENCE CONDITION

D. Schildknecht Jan. 1967 10 p refs

(DESY-67/2)

Sum rules for the isovector nucleon form factor are derived by starting from a divergence condition describing how conservation of the isovector–vector current of hadrons is broken by electromagnetism in lowest order. Author (NSA)

N67-29755# Nordisk Institut for Teoretisk Atomfysik, Copenhagen (Denmark).

THE DYNAMICS OF ELEMENTARY PARTICLES AND THE PION–NUCLEON INTERACTION, COURSE A

J. Hamilton 1966 239 p refs Lectures presented at the Niels Bohr Inst. and at the Nord. Inst. for Teoretisk Atomfysik

(NP-16640)

The discussion of the dynamical theory includes analyticity and causality for classical and elementary particle physics, and for the π–N forward scattering, and the Low relation and T-matrix. The physical applications cover the scattering of light by an atom, and meson (π)–nucleon scattering. The application of the Mandelstam representation is also given. NSA

N67-29756# Columbia Univ., Irvington, N. Y. Nevis Labs.

A TEST OF THE $\Delta S = \Delta Q$ AND $|\Delta I| = 1/2$ RULES AND CP INVARIANCE IN K^0 DECAY

Peter Schmidt (Ph.D. Thesis) Feb. 1967 77 p refs

(Contract AT(30-1)-1932)

(NEVIS-160; R-581; CU-1932-264) CFSTI: HC $3.00/MF $0.65

Several neutral K properties were investigated with K^0 and $\bar{K}^0$ produced by stopping antiprotons in a hydrogen bubble chamber. A total of 735,000 annihilations yielded about 10,000 neutral K decays into charged particles. No disagreement with the $\Delta S = \Delta Q$ rule, the $|\Delta I| = 1/2$ rules, and CP invariance was found. The decay rates for $K_2 \rightarrow \pi^+\pi^-\pi^0$ and $K_2 \rightarrow \pi l \nu$ were measured as being $(1.4 \pm 0.4) \times 10^6$ sec^{-1} and $(9.85 \pm 1.0) \times 10^6$ sec^{-1}, respectively. Author (NSA)

N67-29782# Iowa State Univ. of Science and Technology, Ames.

THERMAL AND MAGNETIC STUDIES OF LIGAND FIELD LEVELS IN CESIUM COPPER CHLORIDE-$CsCuCl_3$

Frank Joseph Rioux, III (M.S. Thesis) Feb. 1967 81 p refs

(Contract W-7405-ENG-82)

(IS-T-154) CFSTI: HC $3.00/MF $0.65

The heat capacity and magnetic susceptibility of powdered $CsCuCl_3$(s) have been measured in the range 5 to 300 and 1.3 to 140°K, respectively. The susceptibility above 60°K fits a Curie–Weiss law $\chi = C/T - \theta + \alpha$ c.g.s.u./mole with $C = 0.470 \pm 0.005$, $\theta = 4.23 \pm 0.05$, and $\alpha = 400 \times 10^{-6}$. An MO model invoking D_4h symmetry in which the unpaired electron is in a b^*_{1g} orbital has been used to fit the susceptibility. The susceptibility departs from Curie–Weiss behavior below 60°K, becoming constant below 10°K, and a co-operative transition is found in the heat capacity at 10°K. The thermodynamic functions are tabulated to 300°K. The following values were found: $S^o_{298.16} = 214.192$ J/mole deg, $H^o_{298.15} - H^o_0 = 93.072$ J/mole deg. Author (NSA)

N67-29784# Tokyo Univ. (Japan). Inst. for Nuclear Study.

PROPOSAL OF NEW TYPE OF EXPERIMENT FOR INVESTIGATION OF LOW-LYING EXCITED LEVELS IN ATOMIC NUCLEI

Mitsuo Sakai 1 Dec. 1966 5 p ref

(INSJ-102) CFSTI: HC $3.00/MF $0.65

A proton with an appropriate energy can produce in the compound nucleus an isobaric analog state which can correspond to the parent nucleus of a beta transition. The electromagnetic transitions from this state to the low-lying states can be intimately related to the beta transitions from the corresponding analog parent state to the same excited states. It is proposed that experiments based on this type of process could be used to investigate low-lying excited levels in nuclei. NSA

N67-29790# Nebraska Univ., Lincoln.

STORED ENERGY IN IRRADIATED SODIUM CHLORIDE

James M. Bunch (Ph.D. Thesis) Feb. 1967 144 p refs

(Contract AT(11-1)-525)

(COO-525-24) CFSTI: HC $3.00/MF $0.65

A differential thermal analysis technique has been used to measure the stored energy in x- and γ-irradiated NaCl containing F-center concentrations of M, R, and higher aggregate centers. The total stored energy from x irradiated pure samples was found to vary approximately linearly with the F-center concentration plus twice the M-center concentration, for F-center concentrations between 3×10^{17} and 13×10^{17} cm^{-3}. The energy per F center, assuming that each M center contributes twice as much energy as one F center, was 12.4 ± 0.3 eV. The total energy from samples which were γ irradiated well beyond the saturation of the F-center concentration at 7×10^{17} cm^{-3} was about 20% larger than that from x-irradiated samples with identical F-center concentrations. Also, it was observed that the scatter in the total

energy values from the x-irradiated samples increased with sample coloration. These effects are attributed to energy contributed by R and higher aggregate centers. It is suggested that the appearance of these centers was partially suppressed in some of the samples by the presence of impurities. This interpretation is consistant with the observation that the stored energy from the calcium-doped sample, in which the appearance of the R and higher aggregate bands was completely suppressed by the impurities, was near the extrapolation of the energy from less heavily colored samples. NSA

N67-29792# Los Alamos Scientific Lab., N. Mex.
SOME RECENT AUGMENTED PLANE WAVE CALCULATIONS
J. H. Wood [1967] 31 p refs Presented at the 96th Ann. Meeting of the Am. Inst. of Mining, Met., and Petrol. Engr., Los Angeles
(Contract W-7405-ENG-36)
(LA-DC-8593; CONF-670206-1) CFSTI: HC $3.00/MF $0.65

The kind of information derivable directly from augmented plane wave band calculations and the reliability of that information are considered. A typical atomic calculation is given briefly, and then the corresponding band calculation is presented. In both calculations the solutions (wave functions and energy eigenvalues) of a one-electron Schroedinger equation are discussed. The element considered in both sets of calculations is Cu. It is concluded that these band calculations can yield good agreement with experiment providing the correct Hamiltonian or potential energy function can be found. NSA

N67-29793# Los Alamos Scientific Lab., N. Mex.
HIGH-TEMPERATURE NEUTRON-DIFFRACTION STUDY OF LaC_2 AND YC_2
A. L. Bowman, N. H. Krikorian, G. P. Arnold, T. C. Wallace, and N. G. Nereson [1967] 36 p refs Presented at the 6th Rare Earth Res. Conf., Gatlinburg, Tenn.
(Contract W-7405-ENG-36)
(LA-DC-8451; CONF-670502-1) CFSTI: HC $3.00/MF $0.65

Examination of LaC_2 and YC_2 by high-temperature neutron- and X-ray-diffraction and by thermal analysis is reported. A tetragonal to cubic transformation has been observed at 1060°C for LaC_2 and at 1320°C for YC_2. The lattice parameters of LaC_2 are a = 4.00, c = 6.58A at 900°C and a = 6.02A at 1150°C. The parameters of YC_2 are a = 3.74, c = 6.20A at 1100° and a = 5.66A at 1400°C. The structure of the tetragonal phases was found to be of the C11a CaC_2-type, in agreement with previous room temperature results. The structure of the cubic phases is on the B1 NaC1-type with C_2 groups, similar to the structure of KCN. Both phases are isomorphous with the corresponding UC_2 phases. Author (NSA)

N67-29796# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
IMPS: AN INFINITE MEDIUM PHOTON SPECTRUM CODE
T. E. Dudley and M. R. Mendelson 1 Dec. 1966 37 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6571) CFSTI: HC $3.00/MF $0.65

The program IMPS is an infinite medium spectrum code for gamma rays written in FORTRAN II for the Philco 2000. Edits of few-group constants, including the Legendre moments of the group-to-group scattering cross sections, are available for use in transport codes. These moments are based on the Klein–Nishina formula for unpolarized photons. Cross sections are calculated from the bivariate expansions of Capo. The running time per case is short, although somewhat longer than comparable neutron slowing down codes. However, this is not serious for design work as gamma heating calculations and shielding studies do not involve the vast number of "computer runs" which the neutron problems do. The running time of IMPS does increase rapidly, however, with the number of Legendre moments requested. Author (NSA)

N67-29798# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.
PRINCIPALS AND PROBLEMS IN NEUTRON NUCLEAR DATA EVALUATION
J. J. Schmidt Oct. 1966 20 p refs Presented at the Intern. Atomic Energy Agency Conf. on Nucl. Data, Paris, 17–21 Oct. 1966
(KFK-457; CONF-661014-48) CFSTI: HC $3.00/MF $0.65

Some of the main physical problems encountered in the preparation of evaluated neutron cross sections are described. The difficulties involved in systematizing and automatizing the evaluation process are discussed. Examples are given which demonstrate some of the problems involved in this kind of data processing. NSA

N67-29799# Kernforschungszentrum, Karlsruhe (West Germany). Inst. fuer Angewandte Kernphysik.
MEASUREMENTS OF EFFECTIVE (RESONANCE-SHIELDED) NEUTRON CROSS-SECTIONS IN THE keV REGION
H. Miessner and E. Arai Oct. 1966 14 p refs Presented at the Intern. Atomic Energy Agency Conf. on Nucl. Data, Paris, 17–21 Oct. 1966
(KFK-451; CONF-661014-45) CFSTI: HC $3.00/MF $0.65

The pulsed-neutron technique was used to measure capture and transport cross sections in Pb and ^{238}U in the keV energy range. In this method, a short burst of protons was produced by a pulsed 3-MeV Van de Graaff (pulse time 1 or 10 nsec, repetition rate 0.5 or 1 Mc/sec). The pulsed proton beam passes through an electrostatic pick-up system which provides the zero timing pulse. The $^{7}Li(p,n)^{7}Be$ reaction yields 30-keV neutrons near threshold (with energy spread of ±6 keV); the $^{45}Sc(p,n)^{45}Ti$ reaction was used to yield neutrons of 7.5 keV with an energy spread of ±0.8 keV at the lowest resonance of the (p,n) cross section. The short bursts of nearly monoenergetic neutrons with energies below the threshold for inelastic scattering were injected into blocks of Pb and ^{238}U, and the decay of the neutron field in the blocks was measured. For these heavy materials, moderation effects are negligible so that the diffusion process can be described by one-group theory, and the neutron field decays exponentially. The effective cross sections of Pb and ^{238}U measured by this technique are tabulated. NSA

N67-29801# Rochester Univ., N. Y. Dept. of Physics.
CROSS SECTION AND FORM FACTOR OF N*(1236) PRODUCTION BY ELECTRONS
Y. Nagashima 2 Mar. 1967 20 p refs
(Contract AT(30-1)-875)
(UR-875-189) CFSTI: HC $3.00/MF $0.65

Under the assumption of the predominance of the magnetic dipole transition, the cross section of N*(1236) by electrons or muons is recalculated in a covariant way in terms of momentum transfer and the invariant mass of the N*. Using the same form factor as that of elastic e–p scattering, the agreement with the experiment in the momentum transfer region $\lesssim 1$ $(BeV/c)^2$ is quite good. Author (NSA)

N67-29804# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEON ISOBAR PRODUCTION IN PROTON–PROTON COLLISIONS FROM 3 TO 7 GeV/c
Charles Martin Ankenbrandt (Ph.D. Thesis) 1966 133 p refs
(Contract W-7405-ENG-48)
(UCRL-17257) CFSTI: HC $3.00/MF $0.65

A systematic study of the reactions $pp \rightarrow pp$ and $pp \rightarrow pN^*$ in the angular range from $\theta_{lab} = 10°$ to $\theta_{cm} = 90°$ at 3, 4, 5, 6, and 7 GeV/c is reported. A "missing mass" spectrometer detected protons resulting from interactions of the Bevatron external proton beam in a liquid hydrogen target. The spectrometer consisted of a series of bending and focusing magnets and a scintillator hodoscope. Peaks in the missing mass spectra occur at

average N^* masses of 1240 ± 6 MeV, 1508 ± 2 MeV, and 1683 ± 3 MeV with average full widths of 102 ± 4 MeV, 92 ± 3 MeV, and 110 ± 4 MeV respectively. In the missing mass region below 2400 MeV no other significant enhancements are found. Comparison of the N^* production cross sections $d\sigma/dt$ near $\theta_{cm} = 90°$ with the predictions of the statistical model indicates partial success of the model. The differential cross sections at fixed energy manifest exponential dependence on $v = [-tu/(t + u)]$, a symmetric function of the Mandlestam variables t and u, which reduces to the squared transverse momentum transfer for elastic scattering. The slopes of these exponentials vary systematically with energy in a way that depends on the particular reaction under consideration; but all these slopes tend toward the same value ($v_0 \approx 0.4$ GeV^2) at the upper limit of the energy range. Author (NSA)

N67-29810# Stanford Univ., Calif. Linear Accelerator Center.
THE ABSOLUTE VALUE OF $A_{xx}(90°)$ FOR PROTON–PROTON SCATTERING AT 11.4 MeV
H. Pierre Noyes Dec. 1966 10 p refs Presented at the Am. Phys. Soc. Meeting, Stanford, Calif., 28–30 Dec. 1966
(Contract AT(04-3)-400)
(SLAC-PUB-238; CONF-661210-2) CFSTI: HC $3.00/MF $0.65

Because of the deterioration of the target under proton bombardment, Catillon, Chapellier, and Garrets normalize their measurments of the proton–proton scattering parameters $A_{xx}(90°)$ and $A_{yy}(90°)$ at 11.4, 19.15, 23.45, and 26.5 MeV to the value of $A_{xx}(90°)$ at 11.4 MeV. In order to provide an absolute normalization for these experiments, it is noted that at 90° the value of A_{xx} is related to the ratio A_{yy}/A_{xx} by the equation $1 + A_{xx} = (1 - A_{yy}/A_{xx})/[(|c|^2/|e|^2) + 1 - A_{yy}/A_{xx}]$ where c and e are two of the four triplet p–p helicity amplitudes defined by Raynal. This result is independent of the singlet amplitude, and further, the unknown ratio $|c|/|e|$ is shown to be well approximated by $(1 + r)/(1 - r)$, where r is 5/6 of the ratio of $L \cdot S$ to tensor contributions of the ^3P phase shifts. It is known from p–p phase shift analyses at higher energy that the $L \cdot S$ interaction is of short range compared to the known one-pion-exchange tensor interaction, and this ratio is expected to be small. Conservative limits at this energy are set by existing p–p models fitted to the higher energy scattering, and in this way r is found to lie between 0.087 and 0.162. The corresponding uncertainty in A_{xx} is ±0.0019, which is negligible compared to the experimental uncertainty of ±0.013 in the measurement of A_{yy}/A_{xx}. It is concluded that $A_{xx}(90°) = -0.984 \pm 0.009$ at 11.4 MeV. Author (NSA)

N67-29819# Oak Ridge National Lab., Tenn.
HIGH CURRENT DC ION BEAMS
George G. Kelley [1966] 10 p refs Presented at the Natl. Particle Accelerator Conf., Washington
(Contract W-7405-ENG-26)
(ORNL-P-2911; CONF-670307-27) CFSTI: HC $3.00/MF $0.65

The beam systems which have been developed for use in high-energy injection experiments in thermonuclear research are described. An attempt is made to compare the quality of these beams (not the relative merit of the injection systems). Problems peculiar to the production of intense dc beams are discussed. Author (NSA)

N67-29821# United Kingdom Atomic Energy Authority, Harwell (England).
A MONTE CARLO TREATMENT OF THE INTERACTION OF AN ELECTRON BEAM WITH A HEAVY TARGET
M. P. Ruffle Sep. 1966 60 p refs
(AERE-R-5172) HMSO: 8s

The general strategy adopted and the treatment of the various reactions involved in investigating the interaction of an electron beam with a heavy target by a Monte Carlo computer program are described. The purpose of the program is to predict the distribution of the heat generated and the neutrons produced. Some results for typical targets are shown, and the performance of the program is discussed. Author (NSA)

N67-29827# California Univ., Livermore. Lawrence Radiation Lab.
LIFETIME OF INDIVIDUAL CHARGED PARTICLES IN A MAGNETIC MIRROR TRAP [VREMYA ZHIZNI OTDEL'NYKH ZARYAZHENNYKH CHASTITS V MAGNITNOI LOVUSHKE S PROBKAMI]
V. M. Belebanov and N. N. Semashko Oct. 1966 88 p refs Transl. into ENGLISH of Gos. Kom. Po Ispol'z. At. Energii, Inst. At. Energii, Moscow, Rept. IAE-1078, 1966
(UCRL-TRANS-10078; IAE-1078) CFSTI: HC $3.00/MF $0.65

The lifetime of individual charged particles in stationary magnetic-mirror traps was measured as function of the various pertinent parameters. Comprehensive theoretical derivations support numerous experimental data presented in the form of graphs and tables. Results confirm the theoretical predictions of the exponentially small character of the changes in magnetic moments relative to the adiabatic parameter during particle motion near the reflection point. For a given Orgy-I magnetic field configuration, the exponent and coefficients of the exponential term of the expression for the change of magnetic moment assuming random and resonant accumulation processes were found. Lifetimes measured in the presence of axially symmetric perturbations of the magnetic field are in satisfactory agreement with the newly derived theoretical expression. For conditions corresponding to absolute retention of particles within a limited space (in "Stoermer zones") there appeared an anomalous increase in electron lifetimes within the trap. NSA

N67-29840# Sandia Corp., Albuquerque, N. Mex.
ANALYTICAL APPROXIMATIONS FOR X-RAY CROSS SECTIONS
Frank Biggs and Ruth Lighthill Feb. 1967 45 p refs
(Contract AT(29-1)-789)
(SC-RR-66-452) CFSTI: HC $3.00/MF $0.65

Analytical approximations efficient for use in computer programs are given for the photoelectric, incoherent-scattering, and energy-transfer cross sections for the range of atomic numbers $1 \leq Z \leq 100$ and in the photon energy interval $E \geq 0.1$ keV. The photoelectric approximations are based largely on experimental data at low energies, whereas at high energies they are constrained to approach the theoretical high-energy limit. The incoherent-scattering cross sections are approximated by rational functions fitted to the Klein–Nishina relations. The effect of round-off error in the usual form of the Klein–Nishina relations is also shown. Approximation parameters are given in tables. Author (NSA)

N67-29858# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
CORRELATIONS AMONG ATOMIC ELECTRONS
Meyer Katzper and Jerome Percus Feb. 1967 75 p refs
(Contract AT(30-1)-1480)
(NYO-1480-68) CFSTI: HC $3.00/MF $0.65

Methods for improving the calculation of energy values for atoms by accounting for the interparticle correlation are presented. An approach using the projection of an intrinsic-state wave function is first studied. A formalism for the use of intrinsic-state density matrices is then presented and applied. The special properties of an oscillator-based density matrix are investigated. As a result of these considerations a special N-body coordinate tranformation is applied to a Slater determinant to form correlated wave function and its related one- and two-body density matrices. A calculation is carried out to show the improvement resulting from this approach. A harmonic atom approach with the use of unitary transformations to obtain a large class of one-body density matrices and guaranteed realizable two-body density matrices is then formulated. The formalism is tested in a calculation on helium. Author (NSA)

N67-29860# California Univ., Livermore. Lawrence Radiation Lab.
NONEQUILIBRIUM BOUND STATE POPULATIONS OF HYDROGENIC IONS IN A STEADY STATE
William H. Grasberger 8 Sep. 1966 38 p refs
(Contract W-7405-ENG-48)
(UCRL-50135) CFSTI: HC $3.00/MF $0.65

The departures of bound-state populations of nearly hydrogenic ions from local thermodynamic equilibrium values are discussed for a gas of charge Z, density ρ, and arbitrary radiation field with no net changes in time. A practical set of equations and formulae which are used in the author's computer program CYCLE, and the methods by which this program treats a single space point with arbitrary radiation field are discussed. The situation of thermodynamic equilibrium is examined, and the special case called the noncyclic approximation is worked out. This case assumes that collisional effects are negligible and that radiative line transitions balance out, so that a given level then has its population determined by the balance between radiative ionizations from that level and recombinations to that level. The general case where collisional effects and line transitions are included, called the cyclic approximation, is considered at length and special formulae for handling the lines are derived. The energy balance equation for free electrons is worked out in detail. Numerical results from a very simple parameter study are presented graphically in terms of domains of validity for the various approximations. Author (NSA)

N67-29865# Joint Inst. for Nuclear Research, Dubna (USSR).
TWO-CENTER PROBLEM OF QUANTUM MECHANICS. III: TERM TABLES [ZADACHA DVUKH TSENTROV KVANTOVOI MEKHANIKI]
L. I. Ponomarev and T. P. Puzynina 1967 87 p refs In RUSSIAN
(JINR-P4-3175) CFSTI: HC $3.00/MF $0.65

The tables are listed which present the results of calculations for some terms of the two-center problem of quantum mechanics which were obtained by the method suggested in the previous papers. Author (NSA)

N67-29866# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
MEASUREMENT OF π^-p-SCATTERING NEAR 180° IN THE 4–7 GeV/c π^--BEAM [IZMERENIE π^--p RASSEYANIYA VBLIZI 180° V PUCHKE π^--MEZONOV S IMPUL'SAMI 4–7 GeV/c]
B. A. Kulakov, E. I. Mal'tsev, P. I. Filippov, O. N. Tsislyak, and E. N. Tsyganov 1967 16 p refs
(JINR-P13-3132) CFSTI: HC $3.00/MF $0.65

The results are given of the scattering cross section measurement near 180° using the filmless spark chamber technique. The following cross section values for the π^--meson momenta in the range of 4–7 GeV/c are obtained: for 4.0, 5.0, 6.0, and 7.0 GeV/c the cross sections 14.9±1.8, 4.1±1.0, 4.6±1.2 and 4.6±2.4 mb/sr, respectively, were found. Author (NSA)

N67-29867# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
EXCITATION ENERGY OF THE SPONTANEOUSLY FISSIONING ISOMERIC STATE IN ^{240}Am
S. Bernkhol'm, I. Borgrin, L. Vestgard, and V. A. Karnaukhov 1967 27 p
(JINR-E7-3180) CFSTI: HC $3.00/MF $0.65

The excitation function for the reaction ^{241}Pu(p,2n)^{240}Am leading to the spontaneous fissioning isomeric state in ^{240}Am was measured with proton energies of 9.6 to 13.6 MeV. The excitation function shows a typical threshold behavior corresponding to the threshold of 10±0.1 MeV. This is 3.15±0.25 MeV higher than the estimated threshold for the ground-state reaction, and it is interpreted as the excitation energy of the isomeric state. Possible reasons for the unusual stability towards γ emission of such a high-lying level are discussed. Author (NSA)

N67-29879# Atomics International, Canoga Park, Calif.
THE ATOMICS INTERNATIONAL EVALUATED NUCLEAR DATA FILES AND ASSOCIATED COMPUTER PROGRAMS FOR THE AUTOMATED PREPARATION OF MULTIGROUP CONSTANTS
H. Alter 24 Feb. 1967 29 p
(Contract AT(04-3)-701)
(NAA-SR-MEMO-12315) CFSTI: HC $3.00/MF $0.65

Input data from the Atomics International Evaluated Nuclear Data File (AIENDF) tape are processed to give spectrum-weighted group-averaged neutron cross sections and other quantities required for the solution of the neutron transport equation by multigroup diffusion and transport theory methods. The calculation of multigroup Doppler-broadened effective resonance integrals and cross sections in the resonance region for a heterogeneous or homogeneous resonance absorber is based on the single-level Breit–Wigner theory with no overlapping of neighboring resonances. Inelastic and elastic scattering transfer matrices are calculated using differential scattering cross section data stored on the AIENDF Angular Distribution Data Tape (ADDT). Multigroup libraries are punched in any of the formats required by the one-dimensional multigroup diffusion theory codes, ULCER, FAIM, FAIM-CELL, CAESAR, AND CAESAR IV; the one-dimensional multigroup S_n transport theory code, DTF; and the spectrum codes, FORM and AILMOE. Author (NSA)

N67-29883# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
WEAK INTERACTIONS AND SYMMETRIES
B. d'Espagnat Nov. 1965 75 p refs
(TH-115) CFSTI: HC $3.00/MF $0.65

A review is presented of recent applications of group theory, and particularly of unitary symmetry, to the problem of weak interactions. Included are discussion in such areas as semi-leptonic $\Delta s=0$ and $\Delta s\neq 0$ interactions; $\Delta s\neq 0$ non-leptonic interactions; the Goldberger–Treiman formula; the K^*, $\bar{K}^*$ complex; currents and their use; currents and renormalization effects; and SU_3 generalities. C.T.C.

N67-29910*# Brandeis Univ., Waltham, Mass.
GREEN FUNCTION THEORY OF FERROMAGNETISM
Vinod Mubayi and Steve P. Heims [1966] 5 p Presented at the Am. Phys. Soc. Meeting, Washington, D. C., 25–28 Apr. 1966 Submitted for publication
(Grant NsG-612)
(NASA-CR-74865) CFSTI: HC $3.00/MF $0.65 CSCL 20J

An approach is discussed whereby an attempt was made to obtain, within the Green function formalism, a connection between the quasi-particle spectrum and the critical behavior without using an explicit decoupling approximation. Attention is centered on the implications of a cube-root behavior of the magnetization near the Curie point on the form of the quasi-particle spectrum and the behavior of the specific heat. Author

N67-29911*# Pittsburgh Univ., Pa. Space Research Coordination Center.
THE CORRESPONDENCE PRINCIPLE IN INELASTIC SCATTERING
J. D. Garcia 8 Dec. 1966 6 p refs
(Grant NGR-39-011-035)
(NASA-CR-81436; SRCC-35) CFSTI: HC $3.00/MF $0.65 CSCL 20J

Ionization of hydrogen by electrons is examined for the case of high incident electron energies. The Born quantum cross section is found to approach the classical expression in the limit of large principal quantum numbers. The energy dependence of the cross section at high energy is discussed; it is expected that the cross sections go smoothly from log E/E to 1/E behavior as n becomes large. Author

N67-29937# European Atomic Energy Community, Geel (Belgium). Joint Nuclear Research Center.
ELASTIC SCATTERING OF NEUTRONS FROM ^{6}Li
H. H. Knitter and M. Coppola Apr. 1967 14 p refs
(EUR-3454.e)

Angular distributions of neutrons elastically scattered from ^{6}Li were measured in the energy region between 1.0 and 2.3 MeV using a fast neutron time-of-flight spectrometer. Flux attenuation and shape corrections were calculated and the final data are presented in the form of coefficients of Legendre polynomial expansions. Author

N67-29981*# National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF GAMMA RADIATION SPECTRUM BETWEEN 0.2 AND 12 GeV AT AN ATMOSPHERIC DEPTH OF 26 GM/CM^2 [MESSUNG DES ULTRASTRAHLUNGS-GAMMASPEKTRUMS VON 0.2 BIS 12 GeV IN EINER ATMOSPHARISCHEN TIEFE VON 26 G/CM^2]
D. Koehn and K. Roehrs Jun. 1967 8 p refs Transl. into ENGLISH from German
(NASA-TT-F-11030) CSCL 20H

The integral and differential energy spectra of secondary cosmic ray photons between 0.2 and 12 GeV are measured at an atmospheric depth of 26 gm/cm^2, using a balloon-borne lead-scintillator-sandwich spectrometer. The configuration of the integral spectrum is approximated by a power law $I_\gamma(>E)\alpha E^{-0.86\pm0.05}$ in the energy range between 0.2 and 8 GeV. The production rate of photons in the upper atmosphere is derived, showing a rate of 1.8×10^{-3} hγ/gm sec ster for the energy range of $125 > E\gamma > 500$ MeV. A comparison with results by other authors is given. Author

N67-29993*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SPIN MAGNETIC EFFECT ON THE POLARIZATION OF THE ELECTRON–ATOM IMPACT RADIATION
Lue-Yung Chow Chiu Jun. 1967 41 p refs
(NASA-TM-X-55817; X-641-67-297) CFSTI: HC $3.00/MF $0.65
CSCL 20H

A new mechanism is proposed to explain the discrepancies between the measured and the expected polarization of the electron–atom impact radiation at threshold energy. The idea is the following: At threshold scattering, the spin of the scattered electron interacts magnetically with the orbital motion of the atomic electrons. The component of this magnetic interaction along the quantization axis will split the magnetic sublevels of the atomic excited states. This splitting will cause the coherent interference of the radiation to become ineffective. The polarization of the radiation is thereby affected and in fact decreases. The expected polarization P is modified by a depolarization factor $f = (1 + \omega^2\tau^2)$, where ω is the frequency splitting of the excited state and τ is the life time of the transition from the excited upper state to a lower state. By using simple product wave function for the excited state, ω and hence P for various singlet–singlet transitions and triplet–triplet transitions have been calculated for helium atom. In general when the principal quantum number of the excited state increases, f increases and approaches unity. Consequently P increases and approaches the expected value. Author

N67-30012 Nihon Univ., Tokyo (Japan).
A MODEL OF WEAK INTERACTIONS AND ITS APPLICATIONS TO THE π- AND K-MESON DECAYS
S. Y. Tsai Mar. 1967 30 p refs
(NUP-67-4) CFSTI: $3.00

A possible model of weak interactions, which is capable of describing both of the semi-leptonic and non-leptonic decays consistently, is proposed and is applied to the π- and K-meson decays. Modified hadronic currents are introduced, each of which is the sum of a vector current and an axial vector current having their respective phase factors. It is suggested that the weak interactions are universal in the sense that the pure-leptonic, semi-leptonic and non-leptonic processes are describable with a common coupling constant. The origin that a significant violation of the $\Delta I = 1/2$ rule is observed in the $K \to 2\pi$ mode but not in the $K \to 3\pi$ mode is shown to be related to the fact of $\Delta\theta = \theta_A - \theta_V \neq 0$, where θ_V and θ_A are two Cabibbo angles characteristic of the vector and axial vector currents respectively. By generalizing the non-leptonic interaction so as to allow CP violation, the amplitude ratio of the $K_L^0 \to \pi\pi$ mode to the $K_S^0 \to \pi\pi$ mode is also discussed. Author

N67-30086# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
NEW RADIOISOTOPES OF RHENIUM AND TUNGSTEN [DOS NUEVOS RADIOISOTOPOS DE RENIO Y TUNGSTENO]
G. B. Baro, J. Flegenheimer, and M. Viirsoo 1966 24 p refs In SPANISH; ENGLISH summary
(CNEA-175)

The new nuclides ^{189}W and ^{190m}Re have been produced and their decay characteristics investigated, while the existence of the recently discovered ^{189}Re has been confirmed. Tungsten 189 was produced by (n, alpha) reaction on natural osmium enriched ^{192}Os. Its half-life is 11 min.–1 min. and it decays by beta rays, with a maximum beta ray energy of about 1.4 MeV. Rhenium 190 was produced by (n,p) reaction on natural osmium and on osmium enriched in ^{190}Os, and by (d, alpha) reaction on enriched ^{192}Os. Its half-life is 2.8±0.2 h and its maximum beta energy about 1.5 MeV. Gamma lines of 60, 120, 190, 230, 380, 560 and 820 KeV were observed. By Szilard–Chalmers process it was investigated whether ^{190m}Re decays to its 3 minutes isomer. These tests have been unsuccessful up to the present. Rhenium 189, produced by (d, alpha n) reaction on ^{192}Os, by (n,p) reaction on ^{189}Os and by (n,np) reaction on ^{190}Os, shows a half-life of 23 h±1 h. Its maximum beta ray energy is about 0.8 MeV. Gamma lines of 65, 140, 170 and 225 KeV have been observed. Author

N67-30108# Istituto Superiore di Sanita, Rome (Italy).
A MONTE CARLO STUDY ON THE LIMITS OF TESTS OF QUANTUM ELECTRODYNAMICS WITH ELECTRON–POSITRON COLLIDING BEAMS
U. Amaldi, Jr., R. Biancastelli, and P. Stein Saclay, France, Inst. Natl. des Sci. et Tech. Nucl., 30 Sep. 1966 11 p refs Presented at the Intern. Symp. on Electron–Positron Colliding Beams, Saclay, France, 26–30 Sep. 1966

Experiments were conducted to check the validity of quantum electrodynamics along with the hypothesis that a muon is a heavy electron. The check was obtained by comparing the experimental results with the absolute value and/or the behavior of the differential cross section $d\sigma/d\Omega$ of the three processes calculated, assuming the validity of quantum electrodynamics as a function of the energy E, equal for the two incoming particles, and of the scattering angle θ. The apparatus used involved two identical detectors on opposite sides of the crossing region, each of which covers an azimuthal angle $\Delta\phi = 60°$ and accepts a scattering angle $30° \leq \theta \leq 150°$. Consideration was given to two problems: (1) What are the upper limits on the single parameter which will be put by each of the three experiments performed at a given energy E and machine luminosity L, revealing the scattered particles in a reasonable solid angle $\Delta\Omega$ for a running time T? (2) What will be the effect of inefficiency of the apparatus and poor knowledge of the radiation corrections on these results? L.E.W.

N67-30109# Istituto Superiore Di Sanita, Rome (Italy).
A STUDY, USING ADONE, OF THE ϕ RESONANCE THROUGH ITS K^+, K^-, μ^+, μ^- AND NEUTRAL DECAYS
U. Amaldi, Jr., R. Biancastelli, and P. Stein 30 Sep. 1966 8 p refs Saclay, France, Inst. Natl. des Sci. et Tech. Nucl., 30 Sep. 1966 8 p refs Presented at the Intern. Symp. on Electron-Positrons Colliding Beams, Saclay, France, 26–30 Sep. 1966

The information to be obtained from using the different channels is reviewed, and the apparatus is briefly described. The modifications in apparatus are mentioned, including changes to permit the addition of glass Cerenkov counters. The data from the K^+K^- channel, the $\mu^+\mu^-$ channel, and the gamma producing decays are discussed. The influence of the hard photon correction is mentioned. N.E.N.

N67-30138* Case Inst. of Tech., Cleveland, Ohio.
NEUTRON FLUX DISTRIBUTIONS: (EXPERIMENT VS. THEORY) FOR A WATER REFLECTED-SPHERICAL CAVITY SYSTEM Final Report
Floro Miraldi, George W. Nelson, Gary Holmberg, and Gerald Skoff 31 Dec. 1966 101 p refs
(Contract NAS3-6214)
(NASA-CR-72231) CSCL 18H

Neutron flux distributions were measured in a system consisting of a large spherical cavity in water. Mathematical models were designed for the experiments and theoretical neutron flux distributions calculated. Three cavity geometries were studied including concentric sphere systems. Cavity fillings were air and BF_3 at various pressures between 0.05 and four atmospheres. Measurements were made by indium foil activation. Foil activation distributions are presented and relative thermal flux distributions are compared to calculated fluxes. Comparison of theory and experiment show good agreement. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-28994# Yale Univ. Observatory, New Haven, Conn.
FREE–FREE RADIATION AT VERY HIGH DENSITY
B. B. Chakraborty and L. Oster Wright-Patterson AFB, Ohio. ARL. Nov. 1966 32 p refs
(Contract AF 33(615)-2360)
(ARL-66-0239; AD-649760) CFSTI: HC $3.00/MF $0.65

A semi-classical treatment of free-free-radiation (bremsstrahlung) at very high densities is presented that concentrates on the collective behavior of the plasma. General formulas that are useful for numerical calculations as well as expansions in terms of Bessel functions are given. Quantum effects and the limitation to non-relativistic, non-degenerate plasmas are discussed. Numerical results are presented for the temperature range 10,000 to 10 to the 7th power degrees K, and for electron densities of 10 to the 20th power to 10 to the 24th power/cc. It is shown that there exists a very limited frequency variation over the above range of temperatures and densities. Author (TAB)

N67-29010*# Farnum (Frank C.) Co., Philadelphia, Pa.
A SELF-SIMILAR SOLUTION TO THE PROBLEM OF THE EXPANSION OF A CYLINDRICAL COLUMN OF CONDUCTING GAS IN A LONGITUDINAL MAGNETIC FIELD [AVTOMODEL'NOYE RESHENIYE ZADACHI O RASSHIRENII TSILINDRICHESKOGO STOLBA PROVODYASCHEGO GAZA V PRODOL'NOM MAGNITNOM POLE]
A. N. Cherepanov and V. I. Yakovlev Washington, NASA, Jun. 1967 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhn. Fiz. (Moscow), no. 2, 1966 p 14–20
(Contract NASw-1497)
(NASA-TT-F-11018) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Nonstationary radial motion of an infinitely long cylindrical column of conducting gas is considered in a time-variable longitudinal magnetic field. On the assumption of the proportionality of static pressure of the plasma on the boundary of the column to the external magnetic pressure, accurate solutions to a system of equations of magnetohydrodynamics are found by the method of variable division. Some numerical calculations are performed and the energy characteristics are computed for the interaction process. Dependances of the ratio of the useful work performed by the gas in an infinite time interval to the initial energy of the column on the magnetic Reynolds number are presented. Author

N67-29011*# Farnum (Frank C.) Co., Philadelphia, Pa.
CORRELATOR FOR STUDYING OSCILLATIONS IN A STATIONARY GAS DISCHARGE [KORRELYATOR DLYA ISSLEDOVANIYA KOLEBANIY V STASIONARNOM GAZOVOM RAZRYADE]
L. N. Korenevskiy, V. N. Belousov, S. S. Sobolev, and A. F. Fetisov Washington, NASA, Jun. 1967 9 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 4, no. 6, 1966 p 786–793
(Contract NASw-1497)
(NASA-TT-F-11019) CSCL 20I

A device is described for obtaining correlation functions of electrical signals in the frequency band of 10–200 kHz; it is employed to investigate a positive turbulent column of a helium discharge. The basic characteristics and diagrams of the components are given. Some of the results obtained in the process of utilizing the instrument are discussed. Author

N67-29032*# Westinghouse Electric Corp., Baltimore, Md.
SOME NASA CONTRIBUTIONS TO THE USE OF PLASMA JET TECHNOLOGY IN CHEMICAL PROCESSING
Howard C. Ludwig Washington, NASA, Jun. 1967 46 p refs
(Contract NASw-1177)
(NASA-CR-813) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Due mainly to the impetus of the space program's specifications for testing materials under conditions of air atmosphere reentry simulation and for space travel and guidance control, space-oriented Federal agencies are concerned with the technology of high temperature air heating and other plasma producing devices. In the fulfillment of these tasks it is always desirable that the acquired technology provides spin-off applications which contribute to the nation's industrial progress. It is the purpose of this writing to point out the economic and technical potentialities of some plasma producing devices in chemical processing, where it is felt the greatest impact on economic welfare may be realized. Author

N67-29048# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
MODE SYNCHRONIZATION PHENOMENA IN UNIVERSAL PLASMA INSTABILITIES
Herbert Lashinsky Jan. 1967 18 p refs Presented at Quiescent Plasmas Conf., Frascati, Italy, Jan. 1967 Submitted for publication
(Contract AT(40-1)-3405; Grant AF-AFOSR-1016-67)
(BN-487; AD-651092) CFSTI: HC $3.00/MF $0.65

A nonlinear mechanism is indicated by which discrete modes in a bounded unstable plasma can give rise to a quasi-continuous turbulence spectrum. The transition from the discrete spectrum to the turbulence spectrum occurs at a critical value of the so-called locking parameter. A given mode is frequency-modulated by a periodic pulling effect when the mode is at the threshold for locking onto a perturbation whose frequency is close to the unperturbed mode frequency. In the present case the perturbation derives from harmonics of lower frequency modes. The broad spectrum associated with the frequency modulated mode provides an effective means for taking the energy contained in the discrete mode and distributing it over a large number of sidebands arranged asymmetrically around the original mode frequency. Author (TAB)

N67-29125# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
NONEQUILIBRIUM STRUCTURE OF HYDROMAGNETIC GAS-IONIZING SHOCK FRONTS IN ARGON
Martin I. Hoffert Feb. 1967 65 p refs
(Contract Nonr-839(38); ARPA Order 529; Proj. Defender)
(PIBAL-1008; AD-650828) CFSTI: HC $3.00/MF $0.65

A low temperature collisionally-ionizing shock with oblique magnetic field is studied to determine whether certain concepts which exist in the current literature are relevant. Nondimensionalized equations governing the nonequilibrium structure of such a front propagating into un-ionized argon are formulated using ionization rates and an electron energy equation. Comparison of the magnitudes of viscous and magnetic Reynolds numbers within this front indicates that, if a structure exists, it must consist of a narrow imbedded viscous shock standing upstream of a much wider hydromagnetic interaction and ionization relaxation zone. Hence, a modified form of the Zeldovich-von Neumann-Doring (ZND) approximation is applicable to the structure problem. It is shown that in this approximation nontrival steady-state structures cannot be constructed for fast gas-ionizing shocks. On the other hand, solutions are possible for slow waves. Author (TAB)

N67-29229# Rheinisch-Westfalische Technische Hochschule, Aachen (West Germany).

INTERACTIONS OF FREE-BURNING ARCS WITH TRANSVERSE GAS FLOWS AND MAGNETIC FIELDS Interim Scientific Summary Report, 1 Dec. 1965–30 Nov. 1966

W. Fucks, E. Fischer, and J. Uhlenbusch Wright-Patterson AFB, Ohio, ARL, Dec. 1966 49 p refs
(Contract AF 61(052)-805)
(ARL-67-0057; AD-650270) CFSTI: HC $3.00/MF $0.65

Interactions between a free burning arc and transverse gas flows without and with magnetic fields perpendicular to the arc axis are studied. For simplification the arc plasma is described by the mono-fluid-approximation, laminar flow is assumed and the problem is reduced to two dimensions. The latter is approximately correct near the symmetry-plane between the electrodes of a very long free burning arc. Analytical and numerical methods are developed to calculate the flow for a given reasonable temperature field and the temperature distribution for a given flow field. For a given approximate temperature distribution the momentum equation is solved including inertial forces, viscous forces and Lorentz forces. An analytic solution for a channel model is compared with the more rigorous numerical calculations. It is shown that strong magnetic fields or inertial forces can cause a back-flow in the arc core. A better approximation of the temperature field is found by solving the energy equation for a given inhomogeneous flow field. The solution leads to an eigenvalue problem, which allows besides the calculation of the temperature distribution a determination of the electric field strength in the arc depending on the flow parameters. TAB

N67-29336# California Univ., Berkeley.

BIBLIOGRAPHY ON THE HIGH-TEMPERATURE CHEMISTRY AND PHYSICS OF GASES AND PLASMAS, NO. 21

L. Brewer comp. 31 Dec. 1966 23 p refs
(NP-16583) CFSTI: HC $3.00/MF $0.65

A listing is given of 87 papers dealing with spectroscopy of interest in high-temperature chemistry. In addition, a listing is given of 111 papers on reactions between gases and condensed phases. NSA

N67-29399*# Douglas Aircraft Co., Inc., Santa Monica, Calif.

THERMAL ABSORPTION IN SEEDED GASES

Valerie C. Burkig Washington, NASA, Jun. 1967 61 p refs
(Contract NASw-1310)
(NASA-CR-811; DAC-59986) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An experimental determination was made of the temperatures achieved when a solid particle dispersion in helium and hydrogen was exposed to radiant energy from a high power xenon flash-tube. Results showed that significant temperature rises can be obtained with the flash heating technique by radiant heating of seeded gases. Temperatures above 4000°K were obtained using Fe and TaC seed. With the exception of the plateau noted in carbon/hydrogen, the peak temperature achieved continued to increase with increasing flash tube energy. Energy balance considerations indicate more efficient utilization of available energy in hydrogen than in helium. The major discrepancy between theory and experiment lies in the fact that observed peak temperatures are lower and occur earlier than predicted. It is surmised that contributing factors to the observed discrepancy could be that: (a) an increase in energy absorption at the cell wall just compensates for decreased absorption in the cloud, or (b) reflection and scattering by the seed material increase as absorption decreases thus giving an effect of constant transmission for optical measurements. It is suggested that further studies include the effect of particle size distribution and of time dependent parameters in the energy transfer process. S.C.W.

N67-29413# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

SIMULATION REQUIREMENTS FOR ROCKET-BORNE ION SAMPLING PROBES Final Report, 1 May 1965–30 Apr. 1966

J. H. de Leeuw 12 Sep. 1966 18 p refs
(Contract AF 19(628)-5134)
(AFCRL-66-672; AD-649854) CFSTI: HC $3.00/MF $0.65

The requirements for laboratory model simulation of a rocket-borne ion-sampling probe are reviewed. Some successful experiments were performed to attain the proper value of the ratio of Debye length to model size. However, in the plasma flows produced so far, the ratio of electron temperature to gas temperature was found to be much higher than that relevant to the ionospheric conditions. Author (TAB)

N67-29449# Rensselaer Polytechnic Inst., Troy, N. Y.

AN EXPERIMENTAL INVESTIGATION OF THE CONDUCTION OF ELECTRIC CURRENT BETWEEN COLD ELECTRODES IN SHOCK-IONIZED AIR PLASMAS

Roger F. Hoppmann Wright-Patterson AFB, Ohio, ARL, Sep. 1966 84 p refs
(Contract AF 33(615)-1080)
(ARL-66-0182; AD-649832) CFSTI: HC $3.00/MF $0.65

Current-voltage characteristics were measured in the ionized test flow behind the incident shock wave in an arc-driven shock tube. The electrode configuration employed in the experiments was of a shielded type and applied voltages of from 1.5 to approximately 100 volts were used to drive the electrode currents. Data were obtained at shock Mach numbers between 17.5 and 18.6 with an initial pressure of 1 mm Hg in the driven section. The degree of ionization of the test flow was approximately .0006. In the intermediate range of electrode potentials, a mechanism, which is based on a simple ionic resistor model, is proposed to provide a possible explanation of the experimental data. For the highest range of electrode potentials employed, the current approached a limiting value. In all ranges of electrode potential employed the cathode boundary layer is found to play a dominant role in controlling the flow of current. Electrical breakdown was observed in some cases when high electrode voltages were employed. When breakdown occurs, the cathode current becomes extremely nonuniform, with the average cathode current density being more than an order of magnitude greater than the local value measured at the center of the cathode surface. The anode current, on the other hand, remains fairly uniform over the electrode surface. Author (TAB)

N67-29622# Tennessee Univ., Tullahoma. Space Inst.

THE INFLUENCE OF HALL EFFECT AND INITIAL VELOCITY PROFILE ON MHD FLOW IN THE ENTRANCE REGION OF A PARALLEL PLATE CHANNEL

William T. Snyder and Arsev H. Eraslan Arnold Eng. Develop. Center, Apr. 1967 103 p refs
(Contract AF 40(600)-1113)
(AEDC-TR-67-79; AD-650820) CFSTI: HC $3.00/MF $0.65

A new method is presented for the analysis of MHD flow in the entrance region of a parallel plate channel including the

Hall effect. The method involves a linearization of the inertia terms and the introduction of a stretched axial coordinate. A solution is obtained for the velocity distribution in an incompressible fluid which is valid from the duct inlet to the fully developed region. In practice, flows in which the Hall effect is significant will be compressible. Since the primary objective of the present analysis is to develop the analytical technique for extending the linearization scheme to MHD flows with Hall effect, the constant density assumption is justifiable as a first approximation. From this solution numerical results are obtained for the entrance length, pressure distribution, boundary layer thickness, and wall shear stress distribution in the entrance region for various values of the Hartmann number and the Hall parameter. TAB

N67-29673# Texas Univ., Austin. Plasma Physics Lab.
COLLISIONLESS HEATING AND WAVE AMPLIFICATION THROUGH INTERACTION WITH THE DIAMAGNETIC CURRENT
E. L. Lindman Feb. 1967 21 p refs
(Contract DA-ARO(D)-31-124-G805)
(Rept.-6398.3-P; AD-649914) CFSTI: HC $3.00/MF $0.65

Collisionless heating occurs when a magneto-acoustic wave travels at right angles to a magnetic field in a plasma whose density is increasing in the direction of travel. Inclusion of pressure terms in a fluid description leads to an interaction of the wave with the diamagnetic current and a net transfer of energy from the wave to the plasma. The mechanism is, however, completely reversible in the linear approximation. Consequently a wave travelling out of the plasma is amplified, and the plasma loses energy to it. The energy exchange mechanism is not of the Landau type, hence all of the particles of species exchange energy directly with the wave. A description of the time-average heating effects is obtained by expanding the electromagnetic and the fluid equations in a series in mhos. An appropriate generalization of the WKB approximation is used to solve the high-frequency equations. A method for obtaining a net transfer of energy to the plasma from a wave originating externally by varying the magnetic field strength is also discussed along with the effect of the density gradient on other heating mechanisms. Author (TAB)

N67-29706# Zentralstelle fuer Atomkernenergie-Dokumentation, Frankfurt am Main (West Germany).
DOCUMENTATION OF PLASMA PHYSICS. PART I: EXPERIMENTAL PLASMA PHYSICS, THEORETICAL PLASMA PHYSICS. BIBLIOGRAPHY, AUTHOR INDEX, SUBJECT INDEX. VOLUME 2
D. Hilsenbeck Jan. 1967 152 p
(AED-C-03-04)

A listing is presented of 406 papers dealing with all aspects of plasma research. In addition, subject and author indexes are also included. NSA

N67-29727# Polish Academy of Sciences, Warsaw.
MEASUREMENT OF LUMINOUS FRONT VELOCITY IN A DEVICE WITH THE ROD PLASMA GUN "DP" [POMIARY PREDKOSCI FRONTU SWIECENIA W UKLADZIE Z PRETOWYM DZIALEM PLAZMOWYM "DP"]
Marek Sadowski and Elzbieta Sklandnik-Sadowska May 1966 32 p refs In POLISH
(INR-716/XVIII/PP)

The luminous front velocity of a plasma generated by a new type injector, the rod plasma gun DP, was measured. These measurements were made with a telescope of photomultipliers. Luminous front velocity dependence on initial pressure in an expansion chamber, as well as a dependence on the initial voltage of a condenser bank, were investigated. These results are compared with results of calculations on the basis of a simplified energy balance. Time correlations of integral visible radiation of a plasma with the discharge current and magnetic probe signals were also studied. It was corroborated that azimuthal currents play a substantial part in processes that occur in the plasma generated in the rod gun. Author (NSA)

N67-29731# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
MICROWAVE METHODS OF PLASMA STUDY. I: PLASMA DIAGNOSTICS BY MICROWAVE DAMPING AND CUTOFF [MIKROVOLNOVYE METODY ISSLEDOVANIYA PLAZMY. I. DIAGNOSTIKA PLAZMY PO ZATUKHANIYU I OTSECHKE MIKROVOLN]
L. A. Dushin and A. I. Skibenko 1966 36 p refs In RUSSIAN
(FTI-211/R-065)

Methods for the investigation of plasma parameters by microwave damping and cutoff were used in wide application during investigation of various questions of plasma physics. The special characteristics of these methods were deduced. During transverse probing of plasmas, measurement of the amplitude characteristic of signals passed through the plasma made it possible to determine the time and spatial dependence of the density and frequency of compound shocks and, therefore, the temperature of the electrons and processes accompanying the collapse of the plasma (coefficients of diffusion and recombination). Amplitude measurements are greater, the higher the frequency used during plasma probing. Author (NSA)

N67-29732# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
MICROWAVE METHODS OF PLASMA STUDY. II: MICROWAVE PLASMA INTERFEROMETRY [MIKROVOLNOVYE METODY ISSLEDOVANIYA PLAZMY. II. MIKROVOLNOVAYA INTERFEROMETRIYA PLAZMY]
L. A. Dushin and A. I. Skibenko 1966 39 p refs In RUSSIAN
(FTI-212/R-066)

From the analysis of the methods of plasma study based on the changes of phase passing through the plasma waves, the following conclusions were made. The utilization of the phase measurement at one fixed frequency during transverse probing of the usual field made it possible to follow the changes of the mean density with time from the character of the time dependence; the mechanism of the loss of charged particles could be determined; the coefficients of diffusion and recombination could be found; the temperature could be evaluated; and the size of the plasma parameters and the discharge conditions in the retention process and the character of the density decomposition could be determined. If the spatial distribution does not change with time, then the distribution function was determined from the complete phase displacement during change of the density from critical to zero. The utilization of phase measurements with use of some probing frequencies makes it possible to measure the mean and maximum density and to find the distribution function and its variation with time, the temperature, and the diffusion and recombination coefficients. In investigation of magnetoactive plasmas it is always better to use phase measurements on uncommon waves. The change of these waves makes it possible to study plasmas with densities approaching criticality. The change of uncommon waves makes it possible to find the mean value of the density, the frequencies, and their time dependence. Author (NSA)

N67-29733# Akademiya Nauk URSR, Kharkov. Fiziko-Tekhnicheskii Institut.
MICROWAVE METHODS OF PLASMA STUDY. III: PLASMA DIAGNOSTICS BY MICROWAVE REFRACTION [MIKROVOLNOVYE METODY ISSLEDOVANIYA PLAZMY. III. DIAGNOSTIKA PLASMY PO REFRAKTSII MIKROVOLN]
L. A. Dushin and A. I. Skibenko 1966 35 p refs In RUSSIAN
(FTI-213/R-067)

During oblique probing of heterogeneous plasmas with microwave beams, the distribution functions of the particle densities can be found in strata or the distance from gradients of division of plasma-free space in layers with a given density. The investigation of the spatial distribution can be made by refraction of microwave beams of one of several frequencies in the case of flat or cylindrical plasma configurations. The probing of the plasma

cylinder with microwave beams in the horizontal axis makes possible the study of nonhomogeneous plasmas with respect to the gradient and eximuth, in the probing in the plane of the norma axis makes it possible to study nonhomogeneous plasmas with respect to the radius and length of the cylinder axis. The methods for determination of the spatial distribution with utilization of refraction measurements can be used for studies of stationary and pulsed plasmas. Author (NSA)

N67-29742# Maryland Univ., College Park.
MATHEMATICAL MODELS FOR NONLINEAR MODE INTERACTIONS IN BOUNDED PLASMAS
Herbert Leshinsky Oct. 1966 39 p refs Presented at the NATO Advanced Summer Inst. on Nonlinear Phenomena in Plasmas, Orsay, France, 5–23 Sep. 1966 Submitted for publication
(Contract AT(40-1)-3405; Grant AF-AFOSR-1016-67)
(BN-473; ORO-3405-14) CFSTI: HC $3.00/MF $0.65

Mathematical models are devised that will reproduce a number of physical phenomena that have been observed in experiments on instabilities in continuous operating plasma devices. In particular, the description of self-excited, steady-state oscillation in systems that can oscillate in more than one mode simultaneously is discussed. The approach used here is essentially an extension, to disturbed systems, of techniques used in the nonlinear mechanics of lumped-parameter systems. The analysis is limited to spatially bounded systems and the mathematical approach is based on two concepts: (1) asymptotic expansion with respect to a suitably defined small parameter, which will define the magnitude of the nonlinearities that are involved, and (2) expansion in terms of eigenfunctions of linear operators. NSA

N67-29743# Maryland Univ., College Park.
INVESTIGATION OF UNIVERSAL PLASMA INSTABILITIES Annual Progress Report
Herbert Leshinsky 1 Mar. 1967 10 p refs
(Contract AT(40-1)-3405)
(APR-2; ORO-3405-11) CFSTI: HC $3.00/MF $0.65

A brief discussion of the thermal plasma device (Q machine) is presented. A brief outline of the research program is also given. NSA

N67-29748# Stichting Voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.
MICROWAVE DIAGNOSTIC METHODS APPLIED TO JUTPHAAS INJECTION EXPERIMENT
L. Th. M. Ornstein, C. A. J. Hugenholtz, H. A. van der Laan, W. Huizenga, and W. Strijland Aug. 1966 13 p refs Sponsored by EURATOM and Ned. Organisatie Voor Zuiver Wetenschap. Onderzoek
(Rept.-66-33; NP-16588)

Two microwave diagnostic methods have been applied to the Jutphaas Cusp Injection Experiment. The plasma is created by injecting an ion beam into a large vacuum vessel. The plasma causes small phase shifts in an 8-mm interferometer. The minimum phase shift that can be measured is 3×10^{-4} radians, corresponding to a density of about 1.3×10^{8} electrons/cm^3. The high sensitivity is obtained by introducing a calibrated phase shifter; furthermore, sensitive detection is made possible by good mechanical and electrical stabilization of the circuitry. The presence of the plasma in the vessel is also indicated by the shift of the frequency of the fundamental electromagnetic resonance of the vessel itself (TM_{010} mode at 419 Mc). The shift can be observed with a certain time resolution. The two methods are applied simultaneously; the results can be correlated. Author (NSA)

N67-29749# Sydney Univ. (Australia). Wills Plasma Physics Dept.
PERCENTAGE IONIZATION IN CROSSED FIELD LABORATORY PLASMA SOURCES
I. G. Brown, R. C. Cross, B. W. James, and C. N. Watson-Munro Nov. 1966 11 p refs Sponsored by the Australian Inst. of Nucl. Sci. and Eng. and the Australian Res. Grants Comm.
(ER.23; NP-16631)

The results are presented of an experiment to measure the density of neutral particles in a decaying hydrogenous plasma. A large amplitude Alfven waves is propagated through the plasma and since the reionization energy is small compared with the magnetic energy density in the wave the plasma is completely ionized during the passage of the wave. This gives a measure of the total density of the plasma, from which one can subtract the original ion density to obtain the neutral particle density. This technique was used to determine the radial variation of neutrals in various J × B and hybrid plasmas. Author (NSA)

N67-29750# Sydney Univ. (Australia). Wills Plasma Physics Dept.
WILLS PLASMA PHYSICS DEPARTMENT Twelfth Six-Monthly Progress Report, 1 Jul.–31 Dec. 1966
31 Dec. 1966 10 p refs Sponsored by the Australian Inst. of Nucl. Sci. and Eng. and the Australian Res. Grants Comm.
(PR-12; NP-16637)

Brief summaries of continuing research at the Sydney University School of Physics are presented. The areas mentioned are: plasma sources, plasma preparation, compressional wave studies, large amplitude Alfven waves, microwave reflection studies, and longitudinal microwave propagation. Author (NSA)

N67-29751# Sydney Univ. (Australia). Wills Plasma Physics Dept.
THE EFFECTS OF A DENSITY GRADIENT ON THE MAGNETO-KERR EFFECT AT THE BOUNDARY OF A COLLISIONAL PLASMA
N. R. Heckenberg, L. C. Robinson, and G. P. Rothman Oct. 1966 11 p refs Sponsored by the Australian Inst. of Nucl. Sci. and Eng.
(ER.22; NP-16641)

Results are presented of calculations showing the effects of collision frequency and surface-density gradient on the polarization of microwaves reflected from a plasma surface. Experimental observations are compared with these results and estimates are made of the collision frequency and density gradient. Author (NSA)

N67-29752# Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki.
STOCHASTIC DESTRUCTION OF STELLARATOR MAGNETIC SURFACES [STOKHASTICHESKOE RAZRUSHENIE MAGNITNYKH POVERKHNOSTEI STELLARATORA]
B. V. Chirikov 1966 20 p refs In RUSSIAN; ENGLISH summary
(NP-16634)

Some estimates about the stability of the lines of force for a stellarator magnetic field against static perturbations are given. It is shown that increasing of the derivative $d\omega/dz$ (ω is mean rotation speed of the magnetic line at distance z from stellerator's axis around the axis) results in increasing of line stability against resonance perturbations only up to a certain limit. Above that a new so-called stochastic instability may occur. Stochastic instability can be used to realize the so-called Scornyakov's trap which has inside a certain turbulent (in respect to motion of the magnetic lines) or stochastic region surrounded by laminar layer of proper magnetic surfaces. Such a structure can be achieved by additional resonance helical winding which period is equal to the revolution period of the magnetic line in the stochastic region. One may expect the suppression of plasma instabilities in the stochastic region by means of additional damping due to the diffusion of magnetic lines. Author (NSA)

N67-29815# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica.
CALCULATION OF THE IONIZATION RATE IN AN ELECTRICAL DISCHARGE IN CESIUM VAPOUR
A. J. Postma Sept. 1966 28 p refs Sponsored by EURATOM and the Ned. Organisatie voor Zuiver Wetenschap. Onderzoek
(Rept.-66-36; NP-16613)

Calculations were made of the value of the ionization rate in a cesium discharge, taking into account direct ionization and the process of ionization in steps via the resonance level influenced by capture of resonance radiation. The accuracy of the calculation is limited by lack of knowledge on the excitation cross section of transitions between higher energy levels and the first excited states. A second restriction on the accuracy is the fact that mutual transitions between the higher excited states and recombination have been neglected. The calculated ionization rate is, besides a function of the electron temperature, also a function of the electron density and the gas density, as can be expected from measurements of the electron density and temperature as a function of the pressure in the position column of a Cs discharge. A restriction on the usefulness of the calculated values of the ionization rate is the fact that a Maxwellian velocity distribution function has been assumed. Author (NSA)

N67-29817# Stichting voor Fundamenteel Onderzoek der Materie, Juptphaas (Netherlands). Instituut voor Plasma-Fysica.
DIAMAGNETIC PLASMA INJECTION INTO A MAGNETIC CUSP
L. Th. M. Ornstein, C. A. J. Hugenholtz, and H. A. van der Laan Aug. 1966 14 p refs Sponsored by EURATOM and the Ned. Organisatie voor Zuiver Wetenschap. Onderzoek
(Rept.-66-34; NP-16612)

The piercing of the equatorial barrier of a cusped magnetic field by a cylindrical plasmoid is studied. The plasmoid is produced as a short linear pinch discharge, either of a hollow type or of the snowplow type. Completely diamagnetic piercing is only found if a snowplow pinch in hydrogen gas is used; apparently, in this case, the electron temperature is sufficiently high to exclude the field from the plasma during the flow. At a maximum field strength in the barrier of 3.85 kG, piercing is just possible if the plasma density is 8×10^{15} cm^{-3} at a flow velocity of 9×10^{6} cm/sec. The confinement time of the plasma in the central region of the cusp is limited to 4.5 μsec by dissipative mixing of plasma and magnetic field. Author (NSA)

N67-29833# California Univ., Livermore. Lawrence Radiation Lab.
ELECTRIC-FIELD EFFECTS IN Q-MACHINES
Charles W. Hartman and Richard H. Munger 3 Jan. 1967 24 p refs Presented at the Conf. on Phys. of Quiescent Plasmas, Frascati, Italy
(Contract W-7405-ENG-48)
(UCRL-70115; CONF-670104-6) CFSTI: HC $3.00/MF $0.65

The equilibrium and stability of potassium plasma with internal electric fields perpendicular to the confining magnetic field is studied in a single-ended Q machine. An axisymmetric equilibrium is observed to occur only if the thermoelectric potential distribution in the plasma is symmetrical. This requires symmetry of the hot-plate temperature distribution. When the above conditions are satisfied and the plasma core potential is positive ($\nabla_{\text{hot plate}}>0$) low frequency ($\omega\approx\omega_{ci}/10$) flute-like waves ($[k_\phi/k_\parallel]\approx10^2$) are observed which propagate azimuthally at the velocity of the mean ion momentum per unit mass. It is conjectured that the waves are excited by the plasma rotation. When the plasma core potential is negative ($\nabla T_{\text{hot plate}}<0$), large shear exists in the E/B drifts and similar flute-like waves are observed which are localized in the vicinity of maximum shear. The azimuthal phase velocity is not closely synchronous with drifts of either component. In this case wave excitation is conjectured to arise from velocity shear. Author (NSA)

N67-29863# Los Alamos Scientific Lab., N. Mex.
THEORY OF VELOCITY DISTRIBUTIONS ASSOCIATED WITH BOUNDED QUIESCENT PLASMAS
H. Dreicer and W. Riesenfeld [1967] 5 p Presented at the Conf. on Phys. of Quiescent Plasmas, Frascati, Italy
(Contract W-7405-ENG-36)
(LA-DC-8213; CONF-670104-5) CFSTI: HC $3.00/MF $0.65

An investigation is under way, utilizing the Fokker–Planck equation for inverse square forces, which seeks to determine the nature of the electron velocity distribution function in a bounded quiescent plasma. Author (NSA)

N67-29992*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN ANALYSIS OF ALOUETTE I PLASMA RESONANCE OBSERVATIONS
Robert F. Benson Jun. 1967 83 p refs
(NASA-TM-X-55816; X-612-67-287) CSCL 20I

The plasma resonances were analyzed by averaging the data from numerous satellite passes through small regions of space on magnetically quiet days. The cyclotron harmonic resonant frequencies were obtained from the receiver-output amplitude versus time format, and the corresponding magnetic field values were compared with a model field. The data from a low-latitude region clearly indicate that the resonant frequencies deviate from the harmonic relationship $f_n=nf_H$. The maximum observed relative frequency shift is $-0.6\ \pm0.1\%$ between $n=4$ and $n=12$. The resonant frequencies are also sensitive to changes in the electron density, the maximum observed variation being $0.4\pm0.2\%$ for the $n=3$ resonance where the upper hybrid frequency crosses the value of $3f_H$. The data indicate that the region of resonant excitation is not confined to the antenna sheath and does not extend beyond several antenna lengths from the satellite. The physical nature of the observed phenomena is discussed. Author

N67-29994*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ION ACOUSTIC WAVES IN A COLLISIONAL PLASMA
B. Buti Jun. 1967 29 p refs
(NASA-TM-X-55818; X-641-67-303) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The damping of the ion-acoustic waves by Coulomb collisions is studied by using a Fokker–Planck equation for both the species constituting the plasma, namely the electrons and the ions. In a plasma with weak collisions and in the absence of any external field, one finds that irrespective of the ratio of the ion temperature to the electron temperature, T, the characteristic frequency gets affected only by the electron–ion collisons. However, as far as the collisional damping is concerned, both the ion–ion and the electron–ion collisions play a somewhat equally important role; the electron–electron and the ion–electron contributions are negligible compared to the other two. The damping increases with increase in the collision frequency but decreases with increase in T. Author

N67-29999*# Rensselaer Polytechnic Inst., Troy, N. Y.
SEARCH FOR PLASMA OSCILLATIONS STIMULATED BY A PRE-BUNCHED ELECTRON BEAM FROM THE RENSSELAER LINEAR ACCELERATOR
J. S. Mendell and E. H. Holt Washington, NASA, Jul. 1967 55 p refs
(Grant NsG-48)
(NASA-CR-819; TR-67-2) CFSTI: HC $3.00/MF $0.65 CSCL 20I

An experiment is described in which the electron beam from the linear accerator was passed through an argon plasma to discover whether microwave oscillations could be detected outside the discharge vessel. A special microwave bridge and receiver were constructed for the study of the radiation. According to an harmonic analysis of the Linac beam current, based upon an examination of the energy spectrum of the Linac, a peak beam

current of 0.3 A contains a sixteenth harmonic component of about 0.1 A amplitude, whose frequency is the same order of magnitude as the plasma frequency. But this beam current passing through the discharge did not stimulate oscillations that could be detected with a K-band receiver placed outside the vessel. Taking into account the vessel–antenna geometry and the receiver sensitivity, it is concluded that any radiation produced by the beam was at a level lower than 0.4×10^{-10} watts per centimeter of plasma traversed. Author

N67-30040# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ON A SPECTROSCOPIC METHOD FOR MEASURING THE ELECTRON TEMPERATURE OF A PLASMA
Bertil Wilner Royal Swedish Acad. of Eng. Sci., 1966 46 p refs
(PH-41) CFSTI: HC $3.00/MF $0.65

The derivation of the electron temperature of a plasma from measured spectral-line intensities is discussed for a wide temperature and density region. The theory is based on a simple analysis of different types of excitation and ionization equilibria as well as their relaxation times. Special consideration is given to the influence of step-wise processes or a non-Maxwellian electron-velocity distribution. The results are illustrated in a number of diagrams. Author

N67-30043* Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
UPLAZ. A PROGRAM TO CALCULATE THE COMPOSITION OF AN URANIUM PLASMA
H. F. Atwater [1967] 29 p refs
(Grant NGR-10-005-068)
(NASA-CR-85263) CSCL 20I

The program UPLAZ calculates the composition of an uranium plasma as a function of plasma temperature and pressure. The plasma is assumed to be in local thermodynamic equilibrium. Isoelectronic ground state statistical weights are used as uranium ion electronic partition functions. Corrections for the lowering of atomic and ionic ionization potentials are included. A maximum of 12 degrees of ionization can be calculated. This limits the program to maximum temperatures in the range of 90,000 °K to 150,000 °K, depending on the pressure. The individual plasma species are computed in terms of particle density, partial pressure, and percent of total particles. The program is written in FORTRAN IV for the IBM 360/50. Author

N67-30089# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
TEST PARTICLES IN AN ARGON PLASMA
John H. Ormrod Jan. 1967 38 p refs
(AECL-2669) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

The energy loss of fast protons and deuterons traversing an argon hollow cathode discharge has been measured for proton energies of 10 to 70 keV. The plasma electron temperature was $\approx 6 \times 10^{4}$ °K and the number density $\approx 10^{14}$ cm^{-3}. The measured rate of energy loss was much less than the theoretical value. Experimental effects that might explain this discrepancy have been investigated; it is concluded the theory overestimates the rate of energy loss by a factor of two or three. Author

N67-30112# Nagoya Univ. (Japan). Research Information Center.
A POSSIBLE DEFINITION OF ENTROPY FOR WEAK TURBULENCE IN PLASMAS
Toshio Nakayama Mar. 1966 25 p refs
(IPPJ-57)

A possible definition of an H-function which is appropriate to describe weak turbulence in plasmas is introduced in terms of a probability introduced in the functional space spanned by instantaneous solutions of the Vlasov equation. The main point in an introduction of this function is to use an approximate probability. The nature of the H-function thus defined is similar to that introduced by Boltzmann in kinetic theory. The time rate of change of the H-function is computed and it is shown that the rate of change is negative for a weakly turbulent plasma and is zero for a stable plasma. Author

N67-30122*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NUMERICAL CALCULATIONS FOR THE CHARACTERISTICS OF A GAS FLOWING AXIALLY THROUGH A CONSTRICTED ARC
Velvin R. Watson and Eve B. Pegot Washington, NASA, Jun. 1967 220 p refs
(NASA-TN-D-4042) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Numerical programs to obtain solutions for the characteristics of a gas flowing axially through a constricted arc are presented. The numerical programs use real equilibrium gas properties and solve simultaneously the energy, momentum, and continuity equations. Axial conduction, radial pressure gradients, and radial voltage gradients are neglected. The solutions give the arc characteristics in sufficient detail to evaluate the many approximate solutions, and the computing time (approximately 2 min) is sufficiently short that the programs may be used directly to obtain design criteria for plasma generators. Numerical solutions for arcs within 0.635 and 1.27-cm-diameter constrictors are presented and the design optimization of constricted arc plasma generators is discussed. The numerical solutions indicate that with nitrogen, total enthalpies in excess of 5×10^{8} J/kg and velocities in excess of 18,000 m/s may be obtainable at the exit of a constricted arc plasma generator. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-29041# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH Quarterly Technical Summary Report, 1 Nov. 1966–31 Jan. 1967
Alan L. Mc Whorter 4 Apr. 1967 69 p refs
(Contract AF 19(628)-5167)
(Rept.-1967-7:11; ESD-TR-67-162; AD-651065) CFSTI: HC $3.00/MF $0.65

The report covers in detail the solid state research work at Lincoln Laboratory for the period 1 November 1966 through 31 January 1967. The topics covered are Solid State Device Research, Optical Techniques and Devices, Materials Research, and Physics of Solids. Author (TAB)

N67-29084# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.
INFRARED COATING STUDIES Quarterly Report, 16 Dec. 1966–15 Mar. 1967
A. F. Turner 15 Mar. 1967 15 p refs
(Contract DA-44-009-AMC-1707(E))
(QR-3; AD-650222) CFSTI: HC $3.00/MF $0.65

The work was centered on vacuum coating materials for the far infrared spectrum. Four materials were studied in detail. These included PbI2, T1C1, and two organic materials, neutral red dye, and auromine O dye. Using the data obtained in these studies, two low pass filter designs were formulated. The designs incorporate silicon substrates with evaporated films of MgO and T1C1. High transmittance beyond 30 microns is obtained. TAB

N67-29111# Case Inst. of Tech., Cleveland, Ohio.
DEPOSITION OF CARBON ON DIAMOND SEED CRYSTALS
John C. Angus and Herbert Will 20 Feb. 1967 19 p refs
(Contract AF 19(628)-4785)
(AFCRL-67-0155; SR-5; AD-651059) CFSTI: HC $3.00/MF $0.65

Progress was made towards establishing the practicality of growing diamond crystals at low pressures for potential device application. The program of depositions of carbon on diamond seed crystals was continued and non-graphitic surface layers were still found deposited on diamond from methane gas. The crystallographic nature of these layers is being investigated by X-ray and electron diffraction and precision density measurements. The evidence from many experiments, although not conclusive, indicates the surface layers are diamond. The experimental equipment was modified to permit wider variations in deposition conditions and the addition of a dopant gas. Author (TAB)

N67-29236# Franklin Inst., Philadelphia, Pa. Chemistry Dept.
DIFFUSION IN ORGANIC CRYSTALS Semiannual Technical Report, 1 Oct. 1966–31 Mar. 1967
A. R. Mc Ghie and P. J. Reucroft 31 Mar. 1967 42 p
(Contract DA-31-124-ARO(D)-142; ARPA Order 462)
(B2130-T-11; AROD-4168-13-P; AD-650740) CFSTI: HC $3.00/MF $0.65

Further self-diffusion studies were carried out on anthracene crystals at high temperature. A comparison was made between crystals grown from the vapor, the melt and commercially supplied melt-grown crystals in which it was found that the secondary or fast diffusion process increased in the order vapor-grown < melt-grown < commercial melt-grown. A thorough investigation was made into the purity and perfection of a large melt-grown anthracene crystal. Segregation coefficients were obtained for hole and electron traps introduced by thermal decomposition in the melt. An exhaustive study was made on the growth of anthracene crystals from the vapor phase as a function of purification technique, ambient growth atmosphere, growth temperature, supersaturation and the effect of light. The best crystals obtained by this technique gave carrier lifetimes a factor of 5 lower than the best melt-grown crystals. An attempt was also made to examine the physical substructure of anthracene by electron microscopy. TAB

N67-29286# Oak Ridge National Lab., Tenn. Thermonuclear Div.
EXPERIMENTAL SIMULATION OF LARGE, HIGH FIELD, SUPERCONDUCTING MAGNET OPERATION Final Report, 1 Mar. 1966–28 Nov. 1966
Mar. 1967 115 p refs
(Contract W-7405-ENG-26)
(ORNL-TM-1721) CFSTI: HC $3.00/MF $0.65

The following work is reported: Tests with sample coils in external fields; theory and experiments with hard superconductor wire partly in normal, partly in superconducting state ("post quenching currents"); calculations and experiments with compound conductors (high field superconductors, both in the nonresistive and in the flux flow state, in close connection with metallic stabilizers); theory and experiments concerning the critical current of a hard superconductor in zero external field; tests on the influence of premagnetization on the quenching currents of an Nb–25% Zr wire; adiabatic flux jumps of high field superconducting cylinders in longitudinal fields; influence of the surface currents on the performance of cylindrical samples with slowly changing external fields; and flux scanning in the gap between two sections of a cylinder and in the midplane gap between two Nb–25% Zr wire wound coils. Author (NSA)

N67-29329# Massachusetts Inst. of Tech., Cambridge. National Magnet Lab.
HIGH CURRENT DENSITY SUPERCONDUCTING COILS
J. E. C. Williams 1 Feb. 1967 18 p refs Presented at Intern. Colloq. on Intense Magnetic Fields, Their Production and Their Appl., Grenoble, France
(Contract AT(30-1)-3700)
(MIT-3700-1; D-8, CONF-660921-3) CFSTI: HC $3.00/MF $0.65

It is shown that, in a composite with steady-state stabilization, overall current densities can be obtained which are higher than the stabilized short-sample current density. These can be achieved at the expense of stabilized current. It was demonstrated that the function of metallic interleaving in a superconducting composite ribbon coil is probably largely thermal; that is, transient heat transfer to the metallic interleaving during the period of an instability maintains the temperature of the composite low enough for the recovery of superconductivity. The use of mylar as an insulation between the composite and the metal interleaving limits the heat transfer rate to a rather low value; 0.006-cm lead foil does not offer a comparable limitation to the thermal diffusion. It is expected that increased threshold currents could be obtained by the use of inorganic insulation on the ribbon and that thinner lead foil could be used to give higher overall current densities. Author (NSA)

N67-29408# Massachusetts Inst. of Tech., Cambridge.
ELECTRIC FIELD EFFECT ON THE MAGNETORESISTANCE OF INDIUM ARSENIDE SURFACES IN HIGH MAGNETIC FIELDS
Shinji Kawaji and Harry C. Gatos Mar. 1967 26 p refs
(Contract Nonr-3963(05))
(TR-7; AD-650287) CFSTI: HC $3.00/MF $0.65

The electric field effect on the electrical resistance of the surfaces of P-type indium arsenide was studied at 4.2 and 77K in magnetic fields ranging up to 110 kOe. In the absence of a magnetic field such surfaces (prepared by crystallographic cleavage or by etching) were found to be N-type. Their field effect mobility was found to be independent of temperature. In high magnetic fields, the electrons introduced by the capacitively applied electric field increased only slightly the electrical conduction of the etched surfaces at both temperatures and that of the cleaved surfaces at 77K; but they caused nearly no change in the electrical conduction of the cleaved surfaces at 4.2K. It was concluded that in the surface conducting layer the electrons are degenerate and their kinetic energy of the motion perpendicular to the surface corresponds to the lowest quantized level in the narrow surface charge potential well. In high magnetic fields, at 4.2K, the results with the cleaved surfaces were attributed to a 'freeze out' of the carriers (whose momentum perpendicular to the surface is quantized in the surface potential well) due to the quantization of the momentum in the orbital parallel to the surface. The lack of complete 'freeze out' in the etched surfaces was attributed to the microscopic two-dimensional heterogeneities in the surface potential structure. Author (TAB)

N67-29458# Stanford Univ., Calif. Microwave Lab.
CURRENT INSTABILITIES IN PIEZOELECTRIC SEMICONDUCTORS
W. H. Haydl Mar. 1967 207 p refs
(Contract Nonr-225(48))
(ML-1517; AD-651003) CFSTI: HC $3.00/MF $0.65

The report describes the discovery of square-wave type current oscillations and the traveling high electric field domains in cadmium sulfide. Numerous experiments were performed to determine the behavior of the traveling domain, the oscillation conditions and important parameters. Experimental results lead to the conclusion that both current saturation and current oscillations as observed are due to amplification of the sheer wave components of thermal acoustic noise. A simple linear theory which predicts the occurrence of current oscillations in piezoelectric semiconductors has been developed. The saturation of the sample current is also treated theoretically. Good agreement with experimental results is obtained with both theories. The effect of the current saturation and the oscillations on the amplification of an acoustic signal is discussed. Theory indicates that the maximum possible acoustic gain is of the order of 75-100 dB. Author (TAB)

N67-29518# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanics.
STRAIN WAVES IN A 6-CONSTANT CUBIC CRYSTAL
H. S. Paul and W. H. Hoppmann, II Aberdeen, Md., Ballistic Res. Labs., Apr. 1967 9 p refs
(Contract DA-30-069-AMC-589(R))
(AD-650562) CFSTI: HC $3.00/MF $0.65

The analysis is concerned with wave propagation in a 6-constant centrosymmetric cubic crystal. Plane waves propagating in the directions (1, 1, 1), (l, m − l, n) and (l, m, o) are studied. Vibrational waves in an infinite prism are considered. An attempt has been made to analyze the vibration of a cube. It is found that some of the boundary conditions are unsatisfied. But this difficulty can be overcome by considering an infinite thick plate. Vibrational waves in an infinite thick plate bounded by two planes of symmetry are investigated. It may be mentioned that the analysis for the waves in (1, 1, 0) directions will be similar to that of the third problem. The lowest symmetric and antisymmetric modes of waves in cubic crystalline plates are discussed. Both modes change to surface modes whenever surface modes are possible along the direction of propagation. Author (TAB)

N67-29560# Colorado Univ., Boulder. Dept. of Physics and Astronautics.
GALVANOMAGNETIC EFFECTS OF n-In-Sb BELOW 1°K Technical Report, 1 Nov. 1964–31 Dec. 1966
J. H. Wilson, W. F. Love, and S. C. Miller Mar. 1967 22 p
(Contract Nonr-1147(12))
(TR-2; AD-650771) CFSTI: HC $3.00/MF $0.65

Some galvanomagnetic properties of n-InSb have been measured in temperature range from 4K to 0.4K with donor concentrations between 2.6 x 10 to the 15th power/cu cm and 7.5 x 10 to the 13th power/cu cm. The electrical conductivity in zero magnetic field indicated the lack of freezeout for all donor concentrations measured. The transverse magnetoresistance of samples with donor concentrations of 7.5 x 10 to the 13th power/cu cm and 1.0 x 10th to the 14th power/cu cm showed a saturation in magnetic fields less than 10 koe provided the temperature was less than 1K. At temperatures above 1K, the saturation was not observed in any of the samples in magnetic fields up to 16 koe. A possible interpretation of the saturation effect is given by assuming a hydrogen molecule model of the impurities and by taking the dominant scattering mechanism to be due to neutral impurities. Author (TAB)

N67-29685# General Electric Co., Schenectady, N. Y. Research and Development Center.
FERROMAGNETIC DOMAIN STUDIES IN HIGHLY PERFECT METAL PLATELETS AND WHISKERS Final Report, 1 Dec. 1965–30 Nov. 1966
Ralph W. de Blois Mar. 1967 67 p refs
(Contract AF 19(628)-5804)
(AFCRL-67-0107; S-67-1040; AD-649802) CFSTI: HC $3.00/MF $0.65

Nearly perfect thin single-crystal platelets and submicron whiskers of nickel and nickel alloy were used to study nearly ideal ferromagnetic domain and domain wall structures and behavior. Applying fields to classically simple domain patterns leads to new observations of surface pinning and to the formation of several new types of double walls. One type is composed of 180 degree walls of mixed Neel-Bloch structure. Domain observations at the edges and corners of Ni-Co and Ni-Fe platelets with weak negative anisotropy revealed a new tulip pattern that makes clear the process of formation of edge echelons and corner chevrons. Precise determinations of saturation fields at platelet corners and ends were made by examining the resulting domain pattern at low field. Nucleation at the corners and edges of previously saturated thin platelets is observable in low positive and negative fields. Further platelet observations included a field induced stripe pattern in Ni-Co platelets with positive anisotropy, domain walls formed by magnetostrictive anisotropy, and details of spin directions in 180 degree domain walls with various sequences of Bloch walls, Neel walls, and Bloch lines. Individual single-domain nickel whiskers as thin as 600 A have been optically observed, handled, and tested in ferromagnetic nucleation studies. Author (TAB)

N67-29590# Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics.
THERMODYNAMIC FLUCTUATIONS OF THE ORDER PARAMETER IN TYPE II SUPERCONDUCTORS NEAR THE UPPER CRITICAL FIELD H_{c2}
Gert Eilenberger Apr. 1967 29 p refs
(Contract Nonr-401(38))
(TR-19; AD-650856) CFSTI: HC $3.00/MF $0.65

An investigation was made of the mean square deviation of the order parameter from its equilibrium for Type II Superconductors, assuming that the Gibbs free energy is given by a Ginzburg-Landau type functional. It turns out, that the equilibrium function, which is already varying with position because of the penetrating magnetic flux, resists distortion much less than the constant order parameter in type I superconductors. Therefore, the mean square deviation becomes equal in magnitude to the square of the equilibrium order parameter in the magnetic field range ((H sub c2)-B)/(H sub c2) approx. < 0.0001 to 0.00001. This means, that the range of magnetic fields, in which Ginzburg-Landau type descriptions should fail and a singular behavior might show up seems not entirely out of reach of present experimental techniques in contrast to the situation in type I superconductors. Author (TAB)

N67-29601# Naval Ordnance Lab., White Oak, Md.
EFFECTIVE MASS OF FREE CARRIERS IN SEMICONDUCTORS AS DETERMINED FROM INFRARED REFLECTIVITY MEASUREMENTS
Jack R. Dixon 1 Feb. 1967 55 p refs
(NOLTR-67-16; AD-650867) CFSTI: HC $3.00/MF $0.65

Methods are reviewed by which free carrier effective masses of semiconductors are determined from measurements of the infrared reflectivity at normal incidence. This effective mass is referred to as the electric susceptibility mass, (m sub s). The theory upon which the measurements are based is developed. Relationships between (M sub s) and various types of electronic band structure are discussed in considerable detail. Several examples are presented which illustrate the usefulness of such measurements in studying the basic electronic properties of semiconductors. Author (TAB)

N67-29651# Royal Inst. of Tech., Stockholm (Sweden). Microwave Dept.
SUHL-EFFECT IN InSb
Bo Kjellmert 3 Nov. 1966 14 p refs
(Contract AF 61(052)-895)
(SR-10; RADC-TR-67-201; AD-650220) CFSTI: HC $3.00/MF $0.65

The Suhl-effect in InSb in strong electric and magnetic fields was numerically studied taking into account the Hall field, diffusion and both surface and bulk recombination. The results are presented graphically. Author (TAB)

N67-29674# State Univ. of New York, Stony Brook. Dept. of Materials Science.
INVESTIGATION OF THE BAND STRUCTURE OF GROUP V SEMI-METALS AND THE IV–VI SEMICONDUCTORS Annual Summary Report, 1 Apr. 1966–31 Mar. 1967
A. L. Jain 1 Apr. 1967 14 p refs
(Contract NOO16-66-C0194)
(AD-649969) CFSTI: HC $3.00/MF $0.65

Galvanomagnetic measurements were made in single crystals of n-type bismuth–antimony alloys as a function of concentration in the range 0–13 at % sb. The data have been analyzed in terms of two band model. The ratio of the two resistivity components p sub 33/p sub 11 suggests that the electrons in the lower

concentration alloys are located at the same points in the Brillouin zone as those for pure bismuth and that the ratio of the various mobility components is not much influenced on alloying bismuth with antimony. Author (TAB)

N67-29677# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
THERMAL CONDUCTIVITY OF HEAVILY PHOSPHORUS-DOPED SILICON FROM 590° K TO 1280° K
Ralph L. Bønbow (M.S. Thesis) 1 Apr. 1967 42 p refs
(Contract Nonr-2964(01))
(TR-21; AD-649628) CFSTI: HC $3.00/MF $0.65

The thermal conductivity of n-type silicon was studied at high temperatures. The sample measured was a single-crystal phosphorus-doped at 5×10 to the 19 power/cu cm. Measurements were made over temperatures ranging from 588K to 1276K. The series comparative method was used, and Armco iron was used as the standard material. The value of thermal conductivity at 588K was 0.22 watt/(cm-k), the value at 1276K was 0.15 watt/(cm-k). Glassbrenner and Slack give corresponding values of 0.68 watt/(cm-k) and 0.25 watt/(cm-k) for intrinsic silicon. The relative experimental error for measurements was found to be about 20% to 25%. A theory of lattice thermal conductivity, due to Holland, which proposed an inhomogeneous lattice model, was modified by the addition of an electron–phonon term and applied to silicon doped as the sample was doped. The effect of the electron–phonon term was negligible. A value of the disorder parameter gamma of 0.01 caused the theory to agree well with experiment. However it is difficult to justify this large a value of gamma. The electronic component of thermal conductivity was found to be approximately two orders of magnitude smaller than the lattice term over the range measured. Author (TAB)

N67-29708# Brookhaven National Lab., Upton, N. Y.
DESIGN FOR A SUPERCONDUCTING QUADRUPLE
P. F. Dahl and G. Parzen 14 Feb.
(Contract AT(30-3)-GEN-12)
(BNL-11164) CFSTI: HC $3.00/MF $0.65

A superconducting quadrupole, which has four identical planar coils wound from a thin superconducting ribbon, is described. The current density is varied by varying the spacing of the ribbon. NSA

N67-29762# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
NEUTRON IRRADIATION EFFECTS IN FCC, BCC, AND CPH METALS
J. L. Brimhall and B. Mastel Feb. 1967 9 p
(Contract AT(45-1)-1830)
(BNWL-361) CFSTI: HC $3.00/MF $0.65

A brief review of radiation effects on crystal structure of Mo, Ni, and Re is given. Specimens were irradiated under identical flux and temperature conditions, and comparison of the damage state was made as a function of total-exposure, irradiation temperature, and post-irradiation annealing treatment. NSA

N67-29785# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
EVALUATION OF SOLID STATE PURIFICATION OF MOLYBDENUM
W. S. Bennett and F. A. Smidt, Jr. Feb. 1967 9 p refs
(Contract AT(45-1)-1830)
(BNWL-379) CFSTI: HC $3.00/MF $0.65

Several types of Mo were processed in a system employing a recirculating, gettered H_2 atmosphere for C removal. At temperatures up to 1400°C, no removal of C was detected. It was concluded that solid state purification of Mo is not possible by the ZrH_2 method. The most likely possibilities for this failure are discussed. NSA

N67-29788# Nebraska Univ., Lincoln.
SIMULTANEOUS PRODUCTION AND BLEACHING OF F CENTERS
Dennis Owen Covault (Ph.D. Thesis) Dec. 1966 82 p refs
(Contract AT(11-1)-525)
(COO-525-23) CFSTI: HC $3.00/MF $0.65

It has been found that simultaneous irradiation with x rays and light in the neighborhood of room temperature causes a super recovery of the F band upon subsequent x irradiation in the dark, in all KCl crystals tried except for the very pure and the very impure. That is, the F-band growth obtained in the above manner surpasses that of a companion crystal x irradiated only in the dark. The portion of the bleaching spectrum responsible is the F band. This super recovery was not found at liquid nitrogen temperature in KCl or in other alkali halides at room temperature. It was found to increase monotonically with the F-band bleaching intensity to a saturation value. It was also found to be a strong function of the irradiation temperature. There is some evidence from optical bleaching that the F centers in the crystals that were simultaneously x irradiated and bleached differ from those in the crystals that were x irradiated only. Attempts to explain these results theoretically have been unsuccessful. Author (NSA)

N67-29829# Bettis Atomic Power Lab., West Mifflin, Pa.
DETERMINATION OF THE PRINCIPAL COEFFICIENTS OF THERMAL EXPANSION OF α Zr
J. C. Couterne and G. Cizeron 20 Oct. 1966 14 p refs Transl. into ENGLISH from J. Nucl. Mater. (Amsterdam), v. 20, 1966 p 75–82
(WAPD-TRANS-45)

The true mean thermal expansion coefficients of αZr along the principal crystal axes were determined by dilatometry of a hotdrawn rod, the texture of which had been quantatively determined. Two sets of samples were prepared in such a way that their long axes were parallel to different, known crystal vectors. Dilatometry of these samples allows the expansion coefficients along these vectors to be determined. Since the textures are quantitatively known, the expansion coefficients along the a and c crystal axes can be then derived. It was found that the expansion coefficient along the a axis diminishes sharply above 400°C, and the ratio c/a rises sharply above this temperature. This may be due to a change in electronic structure. Author (NSA)

N67-29884# Oak Ridge National Lab., Tenn. Chemistry Div.
ORTEP: A FORTRAN THERMAL-ELLIPSOID PLOT PROGRAM FOR CRYSTAL STRUCTURE ILLUSTRATIONS
Carroll K. Johnson Jun. 1965 133 p refs
(Contract W-7405-ENG-26)
(ORNL-3794) CFSTI: HC $3.00/MF $0.65

A computer program for drawing crystal structure illustrations with a mechanical plotter is described. Ball-and-stick type illustrations of a quality suitable for publication are produced with either spheres or thermal-motion probability ellipsoids on the atomic sites. The program can produce stereoscopic pairs of illustrations which aid in the visualization of complex packing arrangements of atoms and thermal motion patterns. Interatomic distances, bond angles, and principal axes of thermal motion are also calculated to aid the structural study. The Fortran coding utilizes the comparable features of IBM-709/7090 Fortran II and CDC-1604/1604A Fortran 63 with modifications to permit compilation with IBM-360 (and IBM-7090) Fortran IV. The program requires a machine with a memory capacity of 32K words. The machine-oriented plotted subroutines are standard library-type routines with slight modifications. Both CalComp and Benson Lehner off-line magnetic-tape plotting systems have been used successfully. Sample stereo-figure illustrations and a viewer are included. Author (NSA)

N67-30059 Lockheed Missiles and Space Co., Sunnyvale, Calif.
STIMULATED RECOMBINATION RADIATION FROM P–N JUNCTIONS IN InAs
N. S. Baryshev, T. L. Maslennikova, B. P. Pyregov, P. S. Matveeva, E. E. Vdovkin et al [1967] 4 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), no. 4, 1967 p 8–10

Stimulated recombination radiation during pulsed excitation of InAs diodes obtained by diffusion of cadmium in a tellurium-doped n-type single-crystal is investigated. The threshold current density for production of the stimulated emission is approximately 10^4 a/cm^2 at liquid nitrogen temperature. The high value of the generation threshold for InAs (as compared with GaAs) is due to the low quantum efficiency and high internal losses. The peak radiation wavelength is 3.24 micrometers, and is associated with the radiative electron transitions from the conduction band to the acceptor level of the cadmium. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-29151*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLID PROPELLANT ENGINEERING
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 87–103 refs (See N67-29141 16-34)

Density distribution and pressure gradient analyses are discussed for propellant gases in a ballistic system of burning propellants. It is concluded that the energy required to accelerate the gases may be considered second order at low velocities and assumes primacy at higher velocities. Weight and measurement data and static test data are presented for Applications Technology Satellite apogee motors stored for approximately 16 months. A second ATS omnidirectional antenna test is also reported, and results indicate that the igniter impulse was sufficient to separate the antenna-dome from the motor and that the antenna was released and maintained a free flight path satisfactorily. An investigation to determine weight increase of rocket motors with thrust control provided showed that the increases would be 19.03 lb for the Syncom and 28.69 for the ATS motors. N.E.N.

N67-29274# Bettis Atomic Power Lab., West Mifflin, Pa.
THE BEHAVIOR OF THE CRYSTALS AND THE VOIDS IN CENTRALLY HEATED UO_2 GREEN PELLETS
Kiyoski Taketani [1966] 20 p refs Transl. into ENGLISH from Nippon Genshiryoku Gakkaishi (Tokyo), v. 8, 1966 p 249–256 (WAPD-TRANS-47) CFSTI: HC $3.00/MF $0.65

Observations of the microstructure of centrally heated UO_2 green pellets indicate that the outer part usually has a sintered microstructure, but in the central part of the pellet the relation between grains and voids becomes very important. In the higher-temperature parts of the pellet, voids gather near the grain boundaries and form narrow and long voids along the temperature gradient in the pellet. When the edge of the void at higher temperature is heated to a certain temperature, molecules of UO_2 vaporize from this edge and condense at the lower-temperature edge of the void. Repetition of this phenomenon, leads to growth of columnar grains with (111) preferred orientation, and long voids are transformed in shape to lenticular voids. This phenomenon of the grain boundary void transformation is clearly revealed in transversal microstructures. Growth is observed at the low-temperature side of cracks in the pellet, despite prevailing temperatures too low to cause the above-mentioned phenomenon. This grain growth is assumed to be of the common pattern. Author (NSA)

N67-29278# Oak Ridge National Lab., Tenn.
INFLUENCE OF OXYGEN, NITROGEN, AND CARBON ON THE LATTICE PARAMETER OF URANIUM MONOCARBIDE [INFLUENCE DE L'OXYGENE DE L'AZOTE ET DU CARBONE SUR LE PARAMETRE RETICULAIRE DU MONOCARBURE D'URANIUM]
Pierre Magnier (Ph.D. Thesis—Paris Univ.) 1965 63 p refs Transl. into ENGLISH of Comm. a l'Energie Atomique Rept. No. CEA-R-2852
(ORNL-TR-1433)

Results of studies on the effects of O and N on the lattice parameter of U(C,O,N) solid solutions around UC composition are discussed. The data lead to a determination of the solubility of O in UC:U($C_{1-x}O_x$) solid solutions exist if x is smaller than 0.37. The effects of C on the lattice parameter of U–UC solid solutions around UC was also investigated. Results of the study are used as a basis for determining the solubility of U in UC at the different temperatures and their effects on the U–C diagram are analyzed. Author (NSA)

N67-30037*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHANE-FUELED PROPULSION SYSTEMS
Richard J. Weber, James F. Dugan, Jr., and Roger W. Luidens Washington, NASA, 1966 36 p refs Presented at the 2d Joint Propulsion Specialist Conf., Colorado Springs, 13–17 Jun. 1966 Sponsored by AIAA
(NASA-TM-X-52199) CSCL 21D

Liquid methane fuel is superior to JP or kerosene in terms of heating value, cooling capacity, and (possibly) in cost and availability. When it is applied to the difficult commercial supersonic transport mission, it is estimated that the payload capacity can be increased by about 30 percent and the direct operating cost reduced a like amount. Because methane is a good thermodynamic working fluid, there exists the possibility of making further gains in aircraft performance by employing special engine cycles. The cryogenic nature of liquid methane poses unusual problems in handling, storage, and engine and airframe design. However, the magnitude of the potential gains warrants further analysis and experimental work to substantiate the merits of the concept. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-29038*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
ANALYSIS OF A BYPASS AIR CONTROL SYSTEM FOR A SUPERSONIC MIXED-COMPRESSION INLET
Stuart C. Brown Washington, NASA, Jun. 1967 47 p refs
(NASA-TN-D-4032) CFSTI: HC $3.00/MF $0.65 CSCL 21A

An investigation was made of the control system parameters for an example bypass air flow control system for a simulated supersonic mixed-compression inlet. The engine inlet was simulated through use of an analog computer; the flow nonlinearities considered were obtained from wind-tunnel tests. A criterion was developed for determining control system parameters, including effects of pressure signal location, for a given inlet. Effects of variations in the stability constraint on the desired signal shape for a predetermined combination of linear system dynamics were obtained. Effects of typical static pressure variations at different locations in the inlet when used as control signals were investigated. An investigation was also made with a linearized inlet representation

of effects of different longitudinal signal locations and of variations in the dynamics of the associated control system components. The response of the linearized controlled inlet system to a statistically described longitudinal gust disturbance was calculated. The results showed that the control system requirements for the gust disturbance were less stringent than those for engine disturbances. Author

N67-29060# General Dynamics/Convair, San Diego, Calif.
ION AND PLASMA PROPULSION RESEARCH
Apr. 1967 47 p refs Presented at the 10th AFOSR Contractors Meeting, San Diego, Calif., 3–5 Apr. 1967
(Contract AF 49(638)-1558)
(AFOSR-67-0894; AD-651149) CFSTI: HC $3.00/MF $0.65

The pamphlet contains the summaries of the papers presented at the tenth annual AFOSR contractors' meeting on ion and plasma propulsion research, San Diego, California. The paper deals mostly with basic research on plasma power generation and propulsion. Author (TAB)

N67-29153*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH AND ADVANCED CONCEPTS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 130–170 refs (See N67-29141 16-34)

Binary gas breakdown potentials, liquid MHD power conversion, test loop operations, and plasma studies in ion engine are discussed. The breakdown potential was found to have a nonlinear relationship with concentration for gaseous mixtures of nitrogen–helium and helium–argon. Mass transfer and material loss in the liquid metal magnetohydrodynamic power system are predicted and compared with experimental results. Details are presented on the lithium–boiling potassium test loop operational characteristics, and the results of turboalternator and metallurgical examinations are described. The effects of magnetic field strength on the electron energy distribution function for several propellant flowrates and arc conditions in the electron bombardment engine are discussed. N.E.N.

N67-29154*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID PROPULSION
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 171–191 refs (See N67-29141 16-34)

Developments in the areas of gas supply system, impinging sheet injectors, and components in liquid propellant systems are reported. Problems relating to large numbers of pulses and filter contamination in the reaction control system are discussed, and it was concluded that the feasibility of hydrazine plenum warm gas attitude control system was demonstrated. Recent advances in material compatibility with hydrazine and hydrazine/hydrazine nitrate mix propellants, and in heat sterilization of ethylene–propylene elastomeric material with hydrazine and hydrazine stability are described. Details are given on the experiments on a 100-lb impinging sheet injector element with variable spacing between the deflectors and using N_2O_4/N_2H_4 propellants to investigate the degradation in efficiency of the larger injector compared with a 25-lb injector. N.E.N.

N67-29181# Advisory Group for Aerospace Research and Development, Paris (France).
GAS TURBINES
1966 460 p refs In ENGLISH and FRENCH Presented at the 27th Meeting of the AGARD Propulsion and Energetics Panel, Paris, 4–7 Apr. 1966
(AGARD-CP-9, Pt. I) CFSTI: HC $3.00/MF $0.65

Papers on aerodynamics, materials, manufacturing techniques, and design, cooling, and mechanical problems of large gas turbines for aircraft are presented. For individual titles see N67-29182–N67-29202.

N67-29185# Rolls-Royce, Ltd., Derby (England).
PROBLEMS AND POSSIBLE SOLUTIONS PRESENTED BY THE FAN OF LARGE BYPASS ENGINES
G. L. Wilde *In* AGARD Gas Turbines 1966 p 97–108 (See N67-29181 16-28)

The paper discusses the relationship between the fan and the gas generator as the design by-pass ratio is increased. Some of the basic aerodynamic design characteristics of the fan are presented, and it is shown how these can influence the fundamental layout of a high by-pass ratio engine. Several alternative proposals are compared. Author

N67-29186# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).
TWIN SPOOL MOTORS OF HIGH BY-PASS FOR SHORT AND MIDDLE RANGE PROGRAMS—ADAPTATION TO THE CELL [MOTEURS DOUBLE FLUX A TAUX DE DILUTION ELEVES POUR PROGRAMMES A ETAPES COURTES ET MOYENNES—ADAPTATION A LA CELLULE]
L. Bauger, J. Calmon, and C. Bourgarel (Compagn. Gen. Aeron. Marcel Dassault, St. Cloud, France) *In* AGARD Gas Turbines 1966 p 109–133 In FRENCH; ENGLISH summary (See N67-29181 16-28)

High by-pass ratio turbojet investigations have been caused by the search for the lowest possible specific consumptions for subsonic cruise. Assuming that the cruising flight is characterized by conditions where M=0.8 and Z=30,000 ft, it is shown that the specific consumption varies rapidly depending on the ratio of the required cruise thrust to the maximum thrust during takeoff, and the maximum turbine entry temperature during cruise. A reduction of the aircraft cruise drag leads to selecting higher by-pass ratios, determining a total consumption gain due to the decrease of the required thrust and the improvement of the specific consumption. An increase of the turbine entry temperature makes it possible to select a higher by-pass ratio, resulting in a reduction of the specific consumption. As regards engine integration, it would seem that the nacelles arrangement at the rear of the fuselage is adequate for small or average weight aircraft, while for larger aircraft, the best nacelle arrangement would be to install them under the wings. Author

N67-29187# British Aircraft Corp., Weybridge (England).
DESIGN CONSIDERATION OF HIGH BYPASS RATIO ENGINES IN SUBSONIC AIRCRAFT
J. Wotton *In* AGARD Gas Turbines 1966 p 135–148 (See N67-29181 16-28)

Several factors to be considered in the design of high by-pass ratio engines for subsonic aircraft are discussed. Consideration is given to the choice of aircraft configuration, number and location of engines, the basic characteristics of high by-pass ratio, front and aft fans, engine installation at rear and underwing, boundary layer ingestion and engine compatibility, drag reduction by integration, compromising component efficiency with high by-pass ratio and its effect on noise, improving the overall characteristics in the contra-rotating flostat engine, and the by-pass ratio for long or short range aircraft. R.N.A.

N67-29188# Nord-Aviation, Chatillon-sous-Bagneux (France).
CRITICAL PROBLEMS IN THE APPLICATION OF TURBORAMJET TURBOMACHINES AND RAMJETS TO HIGH SPEEDS [PROBLEMES CRITIQUES DAN L'APPLICATION DES TURBOMACHINES TURBOSTATOS ET STATOREACTEURS AUX VITESSES ELEVEES]
A. Gozlan *In* AGARD Gas Turbines 1966 p 149–176 In FRENCH; ENGLISH summary (See N67-29181 16-28)

The fundamental characteristics and limitations of turbomachines and ramjets are presented in order to bring out the need for turboramjet combinations, taking the flight requirements into account. Various combinations of turbomachines and ramjets are then depicted while dwelling on those which were subjected

to application or developed studies. After summarizing the experience gained from the testing of such a mixed propulsion mode, some of the connected critical problems are drawn out. Subsequently, the domain of application of pure ramjets is considered and hypersonic problems discussed. Author

N67-29189# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).

MIXED OPERATION OF THE TURBO-RAMJET [LE FONCTIONNEMENT MIXTE DU TURBOSTATOREACTEUR]

J. Caimon, C. Menioux, and J. Sharp (Bristol Siddeley, Eng.) *In* AGARD Gas Turbines 1966 p 177–218 In FRENCH; ENGLISH summary (See N67-29181 16-28)

For high-speed aircraft, the combined turbo-ramjet engine represents a solution which matches the low consumption of the subsonic by-pass turbojet engine with the very high thrust of the high speed ramjet engine. For a specific Mach number, the air scoop must provide the total air mass flow rate required by the engine, with the optimum pressure recovery and lowest drag. Above Mach 2.0, by-pass turbojet engines with reheat show an appreciable decrease of the specific thrust when the flight speed increases. On the other hand, the ramjet engine is fully efficient only beyond Mo=2.5, so that a specific engine integration is needed for the intermediate range. For transient turbojet operation, the fan pressure ratio should be reduced progressively to open the ramjet for direct admission. There is an optimum value of the by-pass ratio, increasing with the Mach number depending on the turbojet engine characteristics. The volume of the combined combustion chamber is moderate when ramjet operation is limited to high Mach numbers. The initiation of the transition phase is determined by the turbojet characteristics and the ramjet engine geometry determines the end of the transition phase. Author

N67-29190# Technische Hochschule Munchen (West Germany). Institut fuer Flugantriebe.

THE TURBO-RAMJET AS PROPULSION FOR SPACE TRANSPORT VEHICLES [LE TURBO-STATO COMME PROPULSEUR POUR VEHICULES DE TRANSPORT SPATIAUX]

Hans G. Muenzberg *In* AGARD Gas Turbines 1966 p 219–238 In FRENCH; ENGLISH summary (See N67-29181 16-28)

Any consideration of the performance of air breathing engines in the supersonic-hypersonic field should include the type of propulsion systems at present operating in this speed range, e.g. chemical rockets. When designing a turboramjet for a given flight programme, account should be taken, as with all propulsion systems using atmospheric air as propellant, of the specific consumption, the unit thrust, the drag of the cowled engine, and its weight. Moreover, for rockets in this flight phase it is not sufficient to state the specific impulse and the mass ratio alone. An estimation basis is proposed for a consideration of the thermodynamic, aerodynamic, and engineering characteristics of an engine. The design of a turboramjet as a complete propulsion system is discussed and compared with the chemical rocket for use in spacecraft missions. Author

N67-29191# Advisory Group for Aerospace Research and Development, Paris (France).

REVIEW OF REQUIREMENTS FOR AN ENGINE USED FOR VTOL APPLICATION

M. Croy *In its* Gas Turbines 1966 p 239–246 (See N67-29181 16-28)

The evaluation of a jet engine with respect to its use for stabilizing VTOL aircraft has been a difficult problem. This has been mostly due to an incomplete picture of the requirements that need to be fulfilled. However, over the past years experience has been gained in which these requirements have slowly crystalized. This paper reviews these requirements and describes a method for arriving at concrete engine specifications for a given control/stabilization sytem. Author

N67-29195# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Villaroche (France).

GENERAL EXPOSITION OF NEW MECHANICAL PROBLEMS POSED BY GAS TURBINES OF ADVANCED CONCEPTION [EXPOSE GENERAL SUR LES PROBLEMES MECANIQUES NOUVEAUX POSES PAR LES TURBINES A GAZ DE CONCEPTION AVANCEE]

Jean Devriese *In* AGARD Gas Turbines 1966 p 289–306 In FRENCH; ENGLISH summary (See N67-29181 16-28)

Mechanical problems associated with gas turbines required by military aircraft in the 1970 through 1980 period are considered. Attention is given to reducing the size of compressors, combating the increased vibration resulting from higher aspect ratios, fatigue strength and operational life of components made of beryllium and plastics; and to special fabrication methods necessary to meet the more rigid specifications of these advanced gas turbines. Both metallurgical and technical improvements will be necessary for the increased operating temperatures under which these turbines will operate, and new manufacturing processes will be required to adequately machine the components that are required to meet the operating conditions imposed by turbines of the future. Transl. by M.W.R.

N67-29197# General Motors Corp., Indianapolis, Ind. Allison Div.

ANALYSIS AND TESTING OF AIR COOLED TURBINE ROTOR AND STATOR BLADES

H. E. Helms and C. W. Emmerson *In* AGARD Gas Turbines 1966 p 327–354 refs (See N67-29181 16-28)

Advancing turbine engine technology requires air cooled turbines. Cooling mechanisms applied must be exploited in a practical manner to obtain maximum cooling effectiveness. Cooled turbine stator and rotor blade design requires rigorous analysis supplemented by verifying experimental data. Problem definition, analysis techniques, material application, cascade and engine testing, and correlation of data are presented for air cooled turbines. Convection, impingement, film, transpiration and combined cooling mechanisms are reviewed. Author

N67-29428*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

STUDY OF SEPARATION DYNAMICS AND SYSTEMS RELATED TO STAGING OF ATLAS–CENTAUR

Richard W. Heath, Henry Synor, Ralph F. Schmiedlin, and John H. Povolny Washington, NASA, 1967 37 p refs

(NASA-TM-X-52292) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A series of tests was performed on a full-scale model of the Atlas–Centaur vehicle in a test chamber to obtain information concerning the dynamic behavior of the two stages during the separation time interval. At the same time, data were obtained relating to the reliability of the various systems involved in the staging process. The test article motions, in general, conformed to those predicted by dynamics equations, in that the direction of movement observed was the same as that indicated by the dynamics equations, but the magnitude of motion did not agree precisely. As a result of this test series, it was concluded that satisfactory staging of the Atlas from the Centaur will occur, even if one of the eight retrorockets does not fire. The linear shaped charge, which cuts the interstage adapter during the separating sequence, successfully functioned in every test. The detonating train serving the shaped charge performed satisfactorily with the exception of marginal behavior noted in the functioning of a safe and arm device used to initiate the detonation. Author

N67-29457# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

INVESTIGATION OF HIGH ACCELERATION ON THE INTERIOR BALLISTICS OF SOLID PROPELLANT ROCKET MOTORS Final Report, Jul.–Sep. 1966

B. W. Farquhar, D. J. Norton, and J. D. Hoffman Dec. 1968 53 p refs
(Contract DA-01-021-AMC-12864(Z))
(F-66-10; JPC-430; AD-661110) CFSTI: HC$3.00/MF$0.65

An investigation was undertaken on the effects of high acceleration on the interior ballistics of solid propellant rocket motors. A description of the cold flow spin test apparatus and instrumentation is presented. The results of some of the preliminary tests are given and the program for future testing is described. An analytical study is presented which describes various simplified models which account for the effects of rotation on the mass flow and thrust producing capabilities of the nozzle. Results are given for two limiting cases: (1) uniform axial velocity profiles at each plane in the nozzle; (2) uniform angular velocity profiles at each plane in the nozzle. These cases are discussed and a more advanced model is formulated. The complete model is described and future analytical computations are discussed. Author (TAB)

N67-29921# National Aerospace Lab., Tokyo (Japan).
SINGLE-STAGE SOLID PROPELLANT RESEARCH ROCKET (NAL-16)—DESIGN AND FLIGHT EXPERIMENTS
1966 83 p refs In JAPANESE; ENGLISH summary
(NAL-TR-115) CFSTI: HC$3.00/MF$0.65

Two types of the NAL-16 rocket were launched in June 1965, and data obtained for the flight of these single-stage solid propellant research rockets, agreed fairly well with predicted performance. The D-type rocket carried a pulse oscillator, and the IT-type had a 5-channel telemeter. Both types, characterized by high loading density, are stabilized by tail fins and powered with an internal burning solid propellant rocket motor. While the D-type weighs 112.0 kg and the IT-type weighs 117.6 kg, both types are 3,600 mm long and 165 mm in diameter. Peak altitudes for the D-type was 52.2 km with 7.5 kg payload; and for the IT-type it was 37.5 km with 10.3 kg. M.W.R.

N67-30032*# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME V: 260-SL MOTOR CHAMBER AND NOZZLE SHELL FABRICATION OF 18%-NICKEL MARAGING STEEL Final Phase Report
8 Apr. 1966 308 p refs
(Contract NAS3-6284)
(NASA-CR-72126, vol. V) CSCL 21H

The 260-SL motor pressure-vessel material development and fabrication program was conducted to demonstrate the feasibility of producing reliable 260-in.-dia motor chambers and nozzle shells using state-of-the-art materials and fabrication techniques. A material and process evaluation program was conducted to assure complete controllability and understanding of the materials and fabrication techniques used. Two 36-in.-dia Process Evaluation Test Vehicles (PETV) were fabricated and hydrostatically burst tested. The as-built properties of these PETV's were in excess of the minimum design values. The major objective of the program, which was to prove the feasibility of producing reliable 260-in.-dia chambers and nozzle shells, was achieved with the successful hydrostatic proof tests of both the 260-SL-1 and -2 motor chambers and nozzle shells. Author

N67-30033* Aerojet-General Corp., Sacramento, Calif.
260-IN. DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME V: 260-SL MOTOR CHAMBER AND NOZZLE SHELL FABRICATION OF 18%-NICKEL MARAGING STEEL. APPENDIX A: PROGRAM SPECIFICATIONS Final Phase Report
8 Apr. 1967 118 p
(Contract NAS3-6284)
(NASA-CR-72126, v. V, append. A) CSCL 21H

Reported are procurement, process, and nondestructive test specifications for the development of the 260-SL motor chamber and nozzle shell fabrication of 18%-nickel maraging steel. S.C.W.

N67-30034*# Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME V: 260-SL MOTOR CHAMBER AND NOZZLE SHELL FABRICATION OF 18%-NICKEL MARAGING STEEL. APPENDIX B: MATERIAL AND PROCESS EVALUATION PROGRAM Final Phase Report
8 Apr. 1966 440 p
(Contract NAS3-6284)
(NASA-CR-72126, v. V, append. B) CSCL 21H

An appendix presented in support of the material and process evaluation program which was initiated to evaluate the material properties and fabrication process characteristics of the 18%-nickel steel; is reported. All work was performed using the procedures, specifications, equipment, material, and personnel applicable to fabrication of the 260-SL motor chamber and nozzle shell. The effort resulted in the solving of process development problems ranging in character from re-establishing the plate solution-annealing temperature to training personnel for repair welding and operation of the maraging furnace. Presented are data on: the parent plate evaluation; forging material evaluation; parent metal bar stock evaluation; an evaluation of the effects of cold forming on the tensile and fracture-toughness properties of plate; an evaluation of straightening welded joints; the maraging system demonstration; an evaluation of hydrostatic-test fluid; and the process evaluation test vehicles. S.C.W.

N67-30035* Aerojet-General Corp., Sacramento, Calif.
260-IN.-DIA MOTOR FEASIBILITY DEMONSTRATION PROGRAM. VOLUME V: 260-SL MOTOR CHAMBER AND NOZZLE SHELL FABRICATION OF 18%-NICKEL MARAGING STEEL. APPENDIX C: MATERIAL CHARACTERIZATION REPORTS Final Phase Report
8 Apr. 1966 331 p
(Contract NAS3-6284)
(NASA-CR-72126, v. V, append. C) CSCL 21H

Material characterization data are presented on the 18% nickel maraging steel plate, forged, and weld wire materials used in the fabrication of the 260-in diameter rocket engine chamber and nozzle shell. Information is included on the material history and purpose, chemical composition, microcleanliness ratings and grain size, as well as results of strength and fracture toughness data from tensile, slow notch bend, and precracked impact tests. R.N.A.

N67-30102# National Aerospace Lab., Tokyo (Japan).
SOME EXPERIMENTS ON HIGH INTENSITY COMBUSTOR WITH PARTIAL MODELS (II)
Teikichi Otsuka, Hiroshi Fukuda, and Tetsuro Aiba 1967 23 p refs In JAPANESE; ENGLISH summary
(NAL-TR-126)

The aim of this experiment was to develop the high intensity combustor for V/STOL aircraft gas turbines. Experiments were carried out with the box-type combustors which can be considered as partial models of JR-100 engine and with open water courses similar to the box type ones. The flow patterns were determined with five different type combustors under cold air flow and water flow conditions. The features of those flow patterns were correlated with static pressure distribution, exit gas temperature profile and combustion efficiency obtained under burning condition, and some closed relations were found among flow patterns and combustor performances. Author

N67-30103# National Aerospace Lab., Tokyo (Japan).
SOME EXPERIMENTS ON HIGH INTENSITY COMBUSTOR WITH PARTIAL MODELS
Teikichi Otsuka, Hiroshi Fukuda, and Tetsuro Aiba 1966 61 p refs In JAPANESE; ENGLISH summary
(NAL-TR-118) CFSTI: HC$3.00/MF$0.65

The aim of this experiment is to develop the high intensity combustor for V/STOL aircraft gas turbines. Experiments were carried out with the box-type combustors which seemed to be partial models of JR-100 engine. The features of different type

models were compared with each other based mainly on performance such as combustion efficiency, exit temperature profile, pressure loss, static pressure distribution, combustion intensity, etc. and the influence of several factors on their performance was discussed. It has been proved by these experiments that there are several conditions necessary for better high intensity combustors. Author

N67-30148*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ORBIT TRIM PROPULSION REQUIREMENTS FOR SUN SYNCHRONOUS SATELLITES
Daniel L. Endres Jun. 1967 52 p refs
(NASA-TM-X-55825; X-734-67-288) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Two problems are considered in this report. The first is to determine what method of thrusting would be the best for correcting the precession rate of a near sun synchronous satellite to the precession rate of a sun synchronous satellite. The second is to compare five propulsion systems that could fulfill the requirements of such a mission. Special emphasis is placed on the Tiros M mission. It is found that a tangential thrust is the best means for correcting to a sun synchronous orbit from a propulsion standpoint. The results of the propulsion system comparisons are that: 1) the 2 lb. hydrazine system and the 200 sec., I_{sp} resistojet weigh about the same, 2) the 2 lb. hydrazine system requires the least time and, 3) the cold gas resistojet and the 2 lb. hydrazine system require very little power. Thrust misalignment is not considered. Author

N67-30162*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Biotechnology Organization.
STUDY AND PRELIMINARY DESIGN OF AN ISOTOPE-HEATED CATALYTIC OXIDIZER SYSTEM
Thomas M. Olcott [1967] 193 p refs
(Contract NAS1-6256)
(NASA-CR-66346) CFSTI: HC $3.00/MF $0.65 CSCL 21F

Conceptual designs of alternative radioisotope heat sources suitable for use in an isotope-heated catalytic oxidizer system (IHCOS) were accomplished to determine approximate weights of the isotope capsules needed. The finally selected isotope fuel, Pu 238, was based on its minimum weight commensurate with the mission objectives, availability, cost, and safety constraints. A number of candidate catalysts were evaluated to determine their relative effectiveness for methane oxidation. The performance of the selected catalyst, 0.5% palladium was parametrically established. The data obtained were then used to perform an analysis and optimization study in order to define the optimum configuration for IHCOS, which was valid for the dry process gas unit. A second optimization study, utilizing trends established in the first study, was then performed to define the configuration of the moist gas unit. A design of the isotope heat source and catalyst canister was performed for both the moist and dry process gas versions of IHCOS, and resulted in layout drawings of these units. A development plan was prepared for implementing the detailed design fabrication of the IHCOS. L.S.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-29092# Bendix Corp., Ann Arbor, Mich. Aerospace Systems Div.
COSMIC RAY Final Report, 23 Jan. 1966–23 Jan. 1967
Kendle M. Wainio 23 Feb. 1967 64 p refs
(Contract AF 19(628)-5840)
(BSR-2018; AFCRL-67-0149; AD-650887) CFSTI: HC $3.00/MF $0.65

Results of calculations to determine specific yield functions for IGY neutron monitors are reported for vertically incident cosmic ray protons in the range of $1 < Pc < 6$ Gv. The Monte Carlo method is used to calculate secondary nucleon flux intensities at atmospheric depths of 312, 680, and 1000 g/sq cm. Experimental data on neutron monitor response are employed to relate the calculated flux data on count rates, and hence to specific yields, at the corresponding depths. Comparison with empirical data for the specific yield function at sea level shows fair agreement for rigidities less than 3 Gv, but calculated yields are considerably smaller than the empirical data at higher rigidities. Various possible explanations for the discrepancy are discussed. At this time, the most probable cause appears to be the assumption that vertically incident cosmic rays produce most of the counts registered by neutron monitors. Author (TAB)

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-29016*# Holman (John F.) and Co., Inc., Washington, D. C.
THE NATURE OF GEGENSHEIN [O PRIRODE PROTIVOSIYANIYA]
M. G. Karimov Washington, NASA, Jun. 1967 8 p refs Transl. into ENGLISH from Astron. Zh. (Moscow), v. 29, no. 6, 1952 p 633–637
(Contract NASw-1495)
(NASA-TT-F-11035) CSCL 03B

Early ideas held by Russian scientists that the earth has a gaseous (rather than dust) emission comparable to that of comets is upheld and verified by recent observational data of Soviet astronomers. Modern instrumentation yielded photographs which under spectral analysis showed a nitrogen and oxygen spectrum, but proportions could not be calculated. The lines red 6300 Å, green 5577 Å and yellow 5893 Å were used. Author

N67-29021*# Scientific Translation Service, La Canada, Calif.
THE FRENCH SPACE PROGRAM [LE PROGRAMME SPATIAL FRANCAIS]
Andre Lebeau Washington, NASA, Jun. 1967 10 p Transl. into ENGLISH from Sci. Ind. Spatiales (France), v. 3, no. 3/4, 1967 p 27–32
(Contract NASw-1496)
(NASA-TT-F-11068) CSCL 22A

The basic goals are presented for the period of the fifth plan (1966–1970) of the French Space Program for the establishment of permanent launching bases, tracking networks, launch pads and the acquisition of the fundamental technology. This initial investment delineates the scope of French participation in the cooperative European and international space enterprises. An equatorial launch site will be constructed. The CECLES has decided to install a launch pad for the ELDO/PAS launch vehicle. The satellite programs require the use of the French launch vehicle Diamment, the European launch vehicle, and the participation of other leading nations in joint projects. The FR-1 and D-1 programs made it possible to master the basic technology. D-2 and Eole are more ambitious ventures. The latter will cooperate with world-wide meteorological observation projects. Saros is the first French space project in the area of applications. Author

N67-29022*# Scientific Translation Service, La Canada, Calif.
THE SPACE INFRASTRUCTURE IN FRANCE [L'INFRASTRUCTURE SPATIALE EN FRANCE]

Pierre Chiquet Washington, NASA, Jun. 1967 6 p Transl. into ENGLISH from Sci. Ind. Spatiales (France), v. 3, no. 3/4, 1967 p 33–36
(Contract NASw-1486)
(NASA-TT-F-11069) CSCL 22D

Space research necessitates a number of sizeable installations, due to the lengthy and exacting work required in the preparation of experiments. France has had to put a lot of effort into infrastructural work during the fifth development plan, in order to get ready for more ambitious projects. This drive has simultaneously been directed at establishing highly competent scientific and technical laboratories, towards realizing huge investments in related industries, in which the CNES spends more than 80% of its funds, and also toward the construction of powerful launching equipment, such as the Guyana Space Center with its mobile unit to launch rockets, and the balloon launch site at Aire-sur-l'Adour; of tracking equipment (with the Diana Iris network) and of testing and treatment equipment (such as the important Bréti Center). The French effort constitutes a part of the European program and will be of benefit to the world scientific community. Author

N67-29028*# Shock Hydrodynamics, Inc., Sherman Oaks, Calif.
ANALYTICAL STUDY OF IMPACT EFFECTS AS APPLIED TO THE METEOROID HAZARD Final Report
R. L. Bjork, K. N. Kreyenhagen, and M. H. Wagne Washington, NASA, May 1967 191 p refs
(Contract NASw-805)
(NASA-CR-757) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A two-dimensional hydrodynamic code is used to predict effects of impacts at 20 and 72 km/sec by porous and solid materials simulating meteoroids upon aluminum and steel plates. A target strength criterion, incorporating effects of thermal degradation due to residual heating, is used to terminate crater growth in these hydrodynamic analyses. Available data regarding the meteoroid flux are reviewed and interpreted in the light of results of the impact analyses, and a consistent meteoroid mass flux is obtained. Using this environment and the impact effect predictions, penetrating fluxes are obtained as functions of thickness for aluminum and steel. A square meter area of 0.032-in. aluminum is found to have a 0.9 probability of surviving without penetration for one year in a near-earth orbit. Author

N67-29138# Lincoln Lab., Mass. Inst. of Tech., Lexington.
GENERAL RELATIVITY AND ITS EFFECTS ON PLANETARY ORBITS AND INTERPLANETARY OBSERVATIONS
Menasha J. Tausner 7 Oct. 1966 62 p refs
(Contract AF 19(628)-5167)
(ESD-TR-66-444; TR-425; AD-650730) CFSTI: HC $3.00/MF $0.65

A discussion is presented of all aspects of the General Relativity Theory that can be tested at present or in the near future by performance of interplanetary radar experiments. The assumptions underlying general relativity and the mathematical concepts and techniques used are first introduced. Then the approximate equations of motion, to the accuracy needed for the solar system, are derived. Finally, the propagation of electromagnetic waves according to general relativity is considered, and expressions for the time delays and Doppler shifts are obtained. Author (TAB)

N67-29142*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEMS ANALYSIS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 1–12 refs (See N67-29141 16-34)

Continuing research is reported in the following areas: (1) Additional results relating to the periodic orbits for the elliptic aspect of the rectilinear restricted three-body problem are presented. The case with equal masses and the extreme eccentricity-1 is described, and a nonrotating inertial barycentric coordinate system is used. (2) An error analysis was performed on the Mariner Mars 1969 tracking data to determine the effects of range data and infrared spectrometer gas jetting on the celestial mechanics experiment. It was felt that additional range data significantly improves the value of the experiment, and that the gas jetting is insignificant if less than ± 1 dyne over a 90-min period around encounter. (3) A distribution free method involving the spacing of independent sample points is given. (4) Mathematical techniques for studying dispersions of nonlinear systems is also presented. N.E.N.

N67-29158*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LUNAR AND PLANETARY SCIENCES
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 217–223 refs (See N67-29141 16-34)

A description is presented of an experiment to determine Martian surface and cloud-top elevations, depending on the absorption of solar radiation in the Martian atmosphere by CO_2 molecules. The effects of elevation and of temporal and spatial changes on atmospheric absorption are discussed. Diagrams are included for transmission of an assumed Mars atmosphere near 2μ and 2.7μ, and through 16.9μ of H_2O vapor. Balloon observations of radiance of the Earth between 2100 and 2700 cm^{-1} are briefly mentioned. N.E.N.

N67-29180*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DETERMINATION OF THE MASSES OF THE MOON AND VENUS AND THE ASTRONOMICAL UNIT FROM RADIO TRACKING DATA OF THE MARINER II SPACECRAFT
John D. Anderson (Ph.D. Thesis—Calif. Univ., Los Angeles) 1 Jul. 1967 101 p refs
(Contract NAS7-100)
(NASA-CR-84978; JPL-TR-32-816) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Doppler tracking data from the Mariner II spacecraft, which came within 41,000 km of Venus in December 1962, are used. Also, a measure of the lunar inequality by means of the monthly periodic variation in the Doppler curve permits a determination of the Earth–Moon mass ratio. The method of data reduction is a least squares differential correction of the spacecraft's orbit along with the three constants and several other parameters necessary to describe important non-gravitational forces. The geocentric location of the tracking stations and the heliocentric position of Venus are subject to correction also. The differential coefficients are obtained by numerically integrating a set of variational equations along with the equations of motion. Residuals are formed by directly subtracting the computed Doppler data from the observed values. Corrections for light–time, atmospheric refraction, and station timing are applied to the computed data. The results indicate that the Sun–Venus mass ratio is 408505 ± 6, the number of light seconds in one astronomical unit is 499.0036 ± 0.0017 sec and the Earth–Moon mass ratio is 81.3001 ± 0.0013. Author

N67-29297 Advisory Group for Aerospace Research and Development, Paris (France).
RADIO STAR FADEOUTS AND RADIO PROPAGATION
W. A. Flood *In its* Spread F and its Effects upon Radiowave Propagation and Commun. 1966 2 p 287–287 refs (See N67-29281 16-07)
(Contracts AF 39(602)-2077; AF 19(628)-380)

Phase swept interferometers, at 52 and 147 Mc/s on 300, 600 and 900 foot east-west baselines and 1000 and 2000 foot north-south baselines, were used to observe the scintillations of the radio source in Cassiopeia. It is shown that the mean squared phase fluctuations exhibit a λ^2 dependence, and are frequently greater than four square radians when measured on a 900 foot east-west baseline. Meridian transit data for radio star fades were used to compare the mean squared phase fluctuations measured simultaneously on north-south and east-west baselines, and it is found that of 124 cases examined, 39 of these cases indicated a greater loss of fringe visibility on the north-south baseline. It would appear therefore, that on occasion, the irregularities which

produce radio star fadeouts have projections which are more like "pancakes" or flattened spheres than they are high axial-ratio, field-aligned ellipses. Examples of intense phase and amplitude scintillations observed at Maui (52, 147 and 253 Mc/s) and Trinidad (400 Mc/s) are also presented and discussed. The effects of these intense fluctuations upon antenna gain and range and angular resolution are discussed. Author

N67-29298 Advisory Group for Aerospace Research and Development, Paris (France).
BROADBAND RADIO-STAR SCINTILLATIONS
D. G. Singleton *In its* Spread F and its Effects upon Radiowave Propagation and Commun. 1966 2 p 289–312 refs (See N67-29281 16-07)

Twelve months' observations of the scintillations of Cassiopeia A made with a swept-frequency interferometer operating in the frequency range 7.6 to 41 Mc/s are examined statistically. The scintillations, which commonly have bandwidths of 2:1 and larger are occasionally associated with apparent shifts in the positions of the source. Some broadband scintillations also exhibit dispersion. Broadband scintillation occurrence is found to correlate positively with the occurrence of spread F. The focus frequency of those scintillations which exhibit position shifts is found to depend, in a simple way, on the parameters of the associated spread-F configuration. An interpretation of the bandwidth and position-shift features of the scintillations as well as the nature of their association with spread F, is given in terms of the focusing action of elongated irregularities of electron density in the ionosphere. Author

N67-29361# Advisory Group for Aerospace Research and Development, Paris (France).
ORBIT OPTIMIZATION AND LASER APPLICATIONS
Oct. 1964 484 p refs Presented at the Lecture Series on Orbit Optimization and Advanced Guidance Instrumentation, Dusseldorf, 23–24 Oct. 1964
(AGARDograph-92) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. APPLICATION OF OPTIMIZATION TECHNIQUES A. Rosenbloom (Space Tech. Labs.) p 1–21 refs (See N67-29362 16-30)

2. THE APPLICATION OF DYNAMIC PROGRAMMING TO ORBIT TRANSFER PROCESSES F. T. Smith (RAND Corp.) p 23–78 refs (See N67-29363 16-30)

3. STATUS OF LASER TECHNOLOGY R. T. Daly (TRG, Inc.) p 79–108 refs (See N67-29364 16-16)

4. THEORY, METHODS AND APPLICATION OF OPTIMIZATION TECHNIQUES E. L. Peterson (Defense Res. Corp.) p 109–162 refs (See N67-29365 16-19)

5. LASER RECEIVING SYSTEMS B. J. McMurtry (Sylvania Elec. Prod.) p 163–255 refs (See N67-29366 16-16)

6. STATUS OF GUIDANCE AND CONTROL METHODS, INSTRUMENTATION, AND TECHNIQUES AS APPLIED IN THE APOLLO PROJECT W. Haeussermann and R. C. Ducan p 257–484 refs (See N67-29367 16-21)

N67-29362# Space Technology Labs., Inc., Redondo Beach, Calif.
APPLICATION OF OPTIMIZATION TECHNIQUES
A. Rosenbloom *In* AGARD Orbit Optimization and Laser Applications Oct. 1964 p 1–2 refs (See N67-29361 16-30)

Characteristics of existing approximation techniques are considered, including stochastic problems and constraints. Basic equations and boundary conditions are given for a booster powered flight optimization program that will select optimum attitude programs to meet desired end conditions. Convergence of initial conditions is considered, and a sample of an optimization program is included. This assumes a spherical nonrotating earth, universe inverse-square gravitational potential, absence of aerodynamic forces, constant thrust, minimization of thrusting time in the Euler–Lagrange equations but not in the equations of motion. The other version of the proposed program includes variations due to rotation, oblateness, and atmosphere. M.W.R.

N67-29363# RAND Corp., Santa Monica, Calif.
THE APPLICATION OF DYNAMIC PROGRAMMING TO ORBIT TRANSFER PROCESSES
F. T. Smith *In* AGARD Orbit Optimization and Laser Appl. Oct. 1964 p 23–78 refs (See N67-29361 16-30)

The mathematical theory of multistage decision processes is used to describe dynamic programming, and orbit transfer processes are considered as continuous decision processes and as discrete decision processes. System performance indexes are then developed since the optimization of the performance of a dynamic system requires the definition of a mathematical functional to measure the desired performance characteristics, and analytical dynamic programming techniques are used for the optimization of the orbit transfer processes. Analytical dynamic programming as applied to a quadratic performance index and linearized equations of motion are detailed for the optimization of continuous decision processes, and satellite rendezvous is then considered as a continuous decision process. Correction of a 24-hour satellite orbit is treated as a discrete decision process. M.W.R.

N67-29370*# National Aeronautics and Space Administration, Washington, D. C.
FIRST COMPILATION OF PAPERS ON TRAJECTORY ANALYSIS AND GUIDANCE THEORY
1967 227 p refs
(NASA-SP-141) CFSTI: HC $3.00/MF $0.65 CSCL 22C

CONTENTS:

1. FUNCTIONS OF RELAXED CONTROLS J. Warga p 7–20 refs (See N67-29371 16-19)

2. DEVELOPMENT OF MULTIVARIATE FUNCTIONAL MODELS BY LEAST SQUARES D. E. Dupree and R. L. Trauss p 21–36 refs (See N67-29372 16-19)

3. A GENERAL SOLUTION FOR MINIMUM IMPULSE TRANSFERS IN THE NEAR VICINITY OF A CIRCULAR ORBIT T. N. Edelbaum p 37–71 refs (See N67-29373 16-30)

4. REJECTION TO INFINITY IN THE PROBLEM OF THREE BODIES WHEN THE TOTAL ENERGY IS NEGATIVE D. C. Lewis p 73–96 ref (See N67-29374 16-30)

5. AN ALGORITHM TO OBTAIN SERIES EXPANSIONS IN THE THREE-BODY PROBLEM P. Sconzo p 97–120 refs (See N67-29375 16-30)

6. RIGOROUS ERROR BOUNDS ON POSITION AND VELOCITY IN SATELLITE ORBIT THEORIES J. V. Breakwell and J. Vagners p 121–173 refs (See N67-29376 16-30)

7. AN INVESTIGATION OF HIGH ECCENTRICITY ORBITS ABOUT MARS J. V. Breakwell and R. D. Hensley p 175–215 refs (See N67-29377 16-30)

N67-29373*# Analytical Mechanics Associates, Inc., Cambridge, Mass.
A GENERAL SOLUTION FOR MINIMUM IMPULSE TRANSFERS IN THE NEAR VICINITY OF A CIRCULAR ORBIT
T. N. Edelbaum *In* NASA, Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 37–71 refs (See N67-29370 16-30)
(Contract NAS12-26)

An analytic solution is obtained for minimum impulse transfer between two neighboring low-eccentricity orbits. The orientations of the arguments of perigee and the line of nodes are completely arbitrary. The solutions obtained are of three different classes. The first class consists of two-impulse nodal transfers with both impulses occurring on the line of nodes and having equal but opposite radial, circumferential and normal direction cosines for the impulses. The second class also consists of two-impulse solutions but with equal circumferential direction cosines, and equal and opposite

radial and normal direction cosines. The location of the two impulses for this class is a function of the particular transfer. The third class consists of singular solutions with a well-defined thrust direction at every point but with an infinite number of solutions for the distribution of impulses (or even continuous finite thrusts) all having the same fuel consumption. The singular solution can be realized with two impulses so that two impulses suffice for all of these optimum transfers. Author

N67-29374*# Control Research Associates, Baltimore, Md.
REJECTION TO INFINITY IN THE PROBLEM OF THREE BODIES WHEN THE TOTAL ENERGY IS NEGATIVE
D. C. Lewis *In* NASA, Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 73–96 *refs* (See N67-29370 16-30)
(Contract NAS12-93)

Three-body problems are discussed when the total energy is negative and the velocities to the mass-center are sufficiently small for the given configuration. Motions are considered in which there are preassigned values for both potential energy and for the length of the angular momentum vector taken relative to the mass center. The nine second order equations for the three-body is written in the form of three vector equations with a total of ten elementary first integrals. The first six of these integrals express the conservation of linear momentum and permit the use of a frame of reference whose origin is at the center of gravity of the three bodies. Proofs are offered for ten theorems which deal with the rejection to infinity in three-body problems when the total energy is negative. M.W.R.

N67-29375*# International Business Machines Corp., Cambridge, Mass.
AN ALGORITHM TO OBTAIN SERIES EXPANSIONS IN THE THREE-BODY PROBLEM
P. Sconzo *In* NASA, Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 97–120 *refs* (See N67-29370 16-30)
(Contract NAS12-98)

Following an historical review of solutions for three-body problems, the algebra involved in the derivation of a time series solution is discussed. The radius of convergence of this solution in the neighborhood of a noncollision point is then determined according to Sundman; and the property of regularizing variables, particularly the Levi–Civita variable u, is described. The power series solution in the new variable u is constructed by successive approximations in which only elementary algebraic operations are performed on polynomials. By means of the recursion formulas in this computation, the coefficients of the series expansion for all nine coordinates are expressed as functions of the masses and the initial conditions. M.W.R.

N67-29376*# Stanford Univ., Calif.
RIGOROUS ERROR BOUNDS ON POSITION AND VELOCITY IN SATELLITE ORBIT THEORIES
J. V. Breakwell and J. Vagners *In* NASA, Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 121–173 *refs* (See N67-29370 16-30)
(Grant NaG-113-61)

By utilizing results of Hamiltonian theory and the von Zeipel method for treating artificial satellite orbits, error bounds are derived for a general class of orbits with eccentricity less than one. In order to extend the error bounds for the general axisymmetric problem to time intervals of the order $1/J_2$, the known integral of energy is utilized to calibrate the governing differential equations for the rapidly rotating phase. The non-singular rapid phase in this analysis is taken to be the sum of the mean anomaly, argument of periapsis and the right ascension of the ascending node. A corresponding analysis for the general asymmetric problem, including the tesseral harmonics, is also given. From the general error analysis, an algorithm is derived for computating the correct initial conditions that is consistent with the expected accuracy of the theory. Numerical results verifying the conclusions of the theory are presented. Author

N67-29377*# Stanford Univ., Calif.
AN INVESTIGATION OF HIGH ECCENTRICITY ORBITS ABOUT MARS
J. V. Breakwell and R. D. Hensley *In* NASA, Washington 1st Compilation of Papers on Trajectory Anal. and Guidance Theory 1967 p 175–215 *refs* (See N67-29370 16-30)
(Grant NsG-133-61)

Possible long-period fluctuations in the radius of pericenter, r_p, of an orbiter of Mars due to the solar gravitational field are investigated. The study is restricted to a "region of interest" defined by 6000 km $\geq r_p \geq$ 4000 km. Eleven different critical orbital inclinstions are found for which the long-period fluctuations in eccentricity and inclination contain terms of vanishing frequency, suggesting very large amplitudes. A closer analysis of these resonant situations near a critical inclination is accomplished by transforming the Hamiltonian into that of a simple pendulum problem. Maximum variations in the eccentricity, and hence radius of pericenter, are then obtained and curves of maximum change in radius of pericenter versus eccentricity plotted. Author

N67-29387*# Eidgenossische Technische Hochschule, Zurich (Switzerland).
METHODS OF REGULARIZATION FOR COMPUTING ORBITS IN CELESTIAL MECHANICS
E. Stiefel, M. Roesler, J. Waldvogel, and C. A. Burdet Washington, NASA, Jun. 1967 131 p
(Grant NGR-52-058-001)
(NASA-CR-769) CSFTI: $3.00 CSCL 03C

The motion of celestial bodies may be predicted using the methods of classical celestial mechanics. However these methods are cumbersome and inaccurate if the bodies are involved in a near-collision, and break down in an actual collision. An attempt is made to introduce and investigate numerical and analytical methods which deal with this problem. The methods should be able to compute an orbit during and beyond collision, and transformed into perturbation methods, they should converge rapidly also for orbits of arbitrary high eccentricity. This implies the introduction of regularized coordinates and a regularizing time. Furthermore, the classical orbital elements are not unambiguously defined as the eccentricity of the orbit approaches 1. For this reason, and to provide a convenient general theory, regularized elements are also introduced. The general properties of the regularized methods are listed and their advantages and disadvantages are discussed. Also included are computational programs for special and general perturbations with regularized variables, the regularization of the restricted elliptic three-body problem, and some experiments concerning numerical errors. R.N.A.

N67-29415# RAND Corp., Santa Monica, Calif.
AN EXAMPLE OF THE ANALYSIS OF SATELLITE BUNCHING CHARACTERISTICS
G. M. Northrop Feb. 1967 122 p *refs*
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5156-PR; AD-650905) CFSTI: HC $3.00/MF $0.65

The memorandum presents an ad hoc analytical iterative procedure that can be used to establish a desirable relative spacing scheme for families of satellites in unperturbed, unphased, circular, coplanar orbit. Extension of this analytical technique to families of satellites in noncircular coplanar orbit is straightforward. The threefold aim of the Memorandum includes: extension and illustration of an earlier preliminary study; analysis of a practical example (viz., one launch of the IDCSP), with sufficient detail to afford both system managers and analysts insight into the nature of bunchings of satellites in circular, coplanar orbit; and presentation of some procedures and criteria for determining relative spacing between adjacent satellites in the family to give satisfactory system characteristics. TAB

N67-29510# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
COMPUTERIZED EXPANSIONS IN ELLIPTIC MOTIONS
A. Deprit and A. R. M. Rom Feb. 1967 44 p refs *Its* Math. Note No. 504
(D1-82-0601; AD-649611) CFSTI: HC $3.00/MF $0.65

The functions of the Keplerian elliptic motion are expanded with respect to mean anomaly and the eccentricity by applying Poincare's method of continuation in a direct manner to the equations of motion. Two algorithms are proposed; both lead to programs by which the classical expansions are constructed symbolically and automatically on a computer in double precision arithmetic. Even to as high a degree as 30 in the eccentricity, the procedures are remarkably swift. Special care is taken here in describing significant error controls at each step of the recurrences. TAB

N67-29544# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
NEUTRAL HYDROGEN STUDIES OF GALAXIES WITH A SINGLE SPACING INTERFEROMETER
D. H. Rogstad, G. W. Rougoor, and J. B. Whiteoak 1967 41 p refs Submitted for publication
(Contract N00014-67-A-0094-0008)
(AD-649862) CFSTI: HC $3.00/MF $0.65

A total of 79 galaxies were investigated with the Owens Valley Observatory's two-element interferometer for content of neutral hydrogen. The baseline used was 100 ft east-west, and the filter bandwidth was 100 kHz. Thirty of the galaxies had detectable emission. The results are presented as line and position profiles for each galaxy. An extensive investigation of model profiles is also presented for the purposes of interpretation of the observed results. It is shown that while in most cases the position profile cannot be directly interpreted as the rotation curve, the model analysis does suggest a method for estimating the rotational characteristics of the galaxies from the profiles. Using the estimated rotational parameters, total masses were calculated and are presented along with other quantities that describe the character of the galaxies. All of the irregular galaxies that were detected were found to be rotating, with the exception of WLM, which was inconclusive. Author (TAB)

N67-29553# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
RADIO EMISSION NUMBER 2800 FROM ELEVEN QUASI-STELLAR GALAXIES
Allesandro Braccesi (Lab. Nazionale de Radioastron.) 1967 6 p refs Submitted for publication
(Contract N00014-67-A-0094-0008)
(Rept.-3; AD-649893) CFSTI: HC $3.00/MF $0.65

Recently Sandage and Luyten were able to identify eleven quasi-stellar galaxies in a field of the Palomar Observatory-National Geographic Society sky survey. The objects have been selected on the basis of their optical properties alone, thus the sample is unbiased with respect to the radio emission of the objects. A search in the 4C catalog shows that none of the objects is brighter than 2·10 to the −26th power/sq Wm/Hz at 178 MHz. It was possible, however, to detect faint radio emission from this sample of objects using the Owens Valley Radio Interferometer at a frequency of 2800 MHz. Author (TAB)

N67-29579# Naval Research Lab., Washington, D. C.
MILLIMETER-WAVE RADIO ASTRONOMY AT NRL
R. W. Hobbs *In its* Rept. of NRL Progr. Jan. 1967 p 8–15 refs (See N67-29577 16-34)

The state-of-the-art of millimeter-wave astronomy is reviewed, along with observations made since 1947. It is pointed out that atmospheric absorption and emission in the millimeter range interfere with accurate measurements. Current problems involving solar system observations are identified. Present facilities and those under construction are briefly described. N.E.N.

N67-29594# Army Engineer Geodesy, Intelligence and Mapping Research and Development Agency, Fort Belvoir, Va.
STARS' POSITIONS DETERMINED BY COMBINING MICROMETRIC OBSERVATIONS WITH AN OBSERVED KNOWN STAR IN A VERTICAL PLANE CLOSE TO THE MERIDIAN
Angel A. Baldini Feb. 1967 32 p *ref*
(RV-20; AD-649932) CFSTI: HC $3.00/MF $0.65

The research note describes the mathematical formulations developed to provide accurate positions of stars, so that they can be used as reference stars in astronomical photography. Bodies, such as the moon, minor planets, artificial earth satellites, and the like, are photographed against stellar background, and their positions are derived from their orientation to certain known stars, the positions of which have been established. The accuracy in the positions of the bodies depends wholly on the accuracy of the positions of the known stars. The positions determined for some stars selected, however, are of a low order of accuracy. Here, a method and technique for improving accuracy in the positions of these selected stars are employed. The selected stars are to be related among themselves by means of a filar micrometer. If at least one of these stars is chosen to form a pair with a known star's position, and both are observed in the same vertical plane, not far from the meridian, the position of the star can be determined as function of the coordinates of the known star; thus, the positions of all the unknown stars can definitely be determined. Author (TAB)

N67-29642# Manchester Univ., Macclesfield (England). Nuffield Radio Astronomy Labs.
OBSERVATIONS OF GALACTIC AND EXTRA-GALACTIC EMISSION AT 408 Mc/s. THE DETERMINATION OF THE ACCURATE POSITIONS OF RADIO SOURCES BY THE LUNAR OCCULTATION TECHNIQUE. OBSERVATIONS OF EMISSION FROM FLARE STARS Progress Report, Jul.–Sep. 1966
C. G. T. Haslam, M. J. S. Quigley, A. G. Lyne, and A. C. B. Lovell Sep. 1966 7 p
(Contract N62558-3928)
(PR-4; AD-649720) CFSTI: HC $3.00/MF $0.65

Data obtained from the 408 Mc/s nodding scan survey were processed for computer analysis. Several lunar occultations of radio sources were observed using two radio telescopes as an interferometer, but the data have not yet been analyzed. Radio observations were made of the flare star Ross 154 and correlated with simultaneous optical observations made in the USA and USSR. TAB

N67-29642# Smithsonian Astrophysical Observatory, Cambridge, Mass.
MEASUREMENTS OF GAMMA RADIATION FROM THE LUNAR SURFACE AT THE COSMIC STATION LUNA 10
A. P. Vinogradov, Yu. A. Surkov, G. M. Chernov, F. F. Kirnozov, and G. B. Nazarkina [1966] 21 p refs *Its* Astron. Papers Transl. from the Russian, No. 10

The intensity and spectral composition of the lunar rock gamma radiation have been investigated with the aid of a gamma spectrometer mounted on the automatic station Luna 10. The preliminary results of the obtained information processing are given in the article. The investigation results evidence that about 90% of the total intensity of lunar rock gamma radiation is caused by nuclear reactions produced by cosmic rays and only 10% or less belongs to the radiation arising from the decay of the radioactive elements uranium, thorium, and potassium contained in lunar rocks. The general level of gamma radiation intensity over the lunar surface is 1.5 to 2.0 times higher than over terrestrial rocks of the granite type. According to their content of radioactive elements lunar rocks correspond to terrestrial rocks of basic composition basalts. Author

N67-29889*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPACE ENVIRONMENT CRITERIA GUIDELINES FOR USE IN SPACE VEHICLE DEVELOPMENT
Robert E. Smith and Otha H. Vaughan, Jr., ed. 1 Feb. 1967 242 p refs Supersedes NASA-TM-X-53273; see N65-32251
(NASA-TM-X-53521; NASA-TM-X-53273) CSCL 22A

A cross section of space environmental data are presented for use as design criteria guidelines in Marshall Space Flight Center vehicle development programs and advanced studies related to future NASA programs. The data are limited to information above 100 kilometers above the earth and pertain to interplanetary, terrestrial, and cislunar space; the moon; and the planets Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Astrodynamic constants for use in trajectory calculations are also presented, and equations are derived for determining the upper atmosphere kinetic temperature. A program for computing upper atmosphere density is discussed, and a sunspot prediction technique is described. M.G.J.

N67-29890*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR MODULATION OF COSMIC RAYS AND ITS RELATIONSHIP TO PROTON AND HELIUM FLUXES, INTERSTELLAR TRAVEL, AND INTERSTELLAR SECONDARY PRODUCTION
N. Durgar Pasad, C. E. Fichtel, and D. E. Guss Nov. 1966 63 p refs Submitted for publication
(NASA-TM-X-55797; X-611-66-518) CSCL 20H

The general problem of solar modulation of the galactic cosmic radiation is examined with particular emphasis on the solar wind model, and a comparison to the experimental cosmic ray data obtained from 1959 through 1965. The analysis shows that the assumption of similar energy–nucleon spectra at the source for protons and helium nuclei leads to unmodulated spectra with very high intensities at low energies, and a source spectral shape for helium nuclei which is inconsistent with the results from an analysis of helium and heavier nuclei. The assumption of similar rigidity spectra at the source leads to a more reasonable possible source spectral shape. Low energy proton production in interstellar space is considered, and tentative estimates are made of the degree of solar modulation, the energy dependence of the modulation, and the shapes of the source spectra of the primary cosmic ray components. Author

N67-29891*# Bellcomm, Inc., Washington, D. C.
EXPERIMENTAL PAYLOADS FOR A MANNED MARS FLYBY MISSION
F. G. Allen, P. L. Chandeysson, E. M. Grenning, D. B. Hoffman, R. N. Kostoff et al 15 May 1967 127 p refs
(Contract NASw-417)
(NASA-CR-85122; TR-67-233-1) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An experiment payload for this mission would include on board remote sensors and four types of unmanned probes for more direct measurements of the Martian environment. One probe, a Mars surface sample return vehicle, will return a sample from the surface of Mars. The return of a sample is felt to be required to conduct a meaningful biologic investigation of Mars. The three other probe types include an impacter for atmospheric measurements, an orbiter, and a soft lander. The total weight of the experiment payload, including on board sensors, a laboratory for bioanalysis, and the probes is about 34,000 lbs. A program of experiments in astronomy and space physics that uses the on board remote sensors has been developed to capitalize on both the Earth–Mars and Mars–Earth phases of the mission. Author

N67-29944 Academy of Sciences (USSR), Moscow. Astronomy Committee.
RESULTS OF OBSERVATIONS ON ARTIFICIAL EARTH SATELLITES, NO. 80
1966 48 p refs In RUSSIAN

Equatorial and horizontal coordinates are presented in tabulated form for Sputnik 1960 Epsilon, Cosmos XI, XVII, XXV, XXVI, XXX, Polet I and II, and Elektron I as observed from Soviet stations during May 1964 Transl. by K.W.

N67-29947 Academy of Sciences (USSR), Moscow. Astronomy Committee.
RESULTS OF OBSERVATIONS ON ARTIFICIAL EARTH SATELLITES, NO. 79
1966 52 p In RUSSIAN

Tables containing the equatorial and horizontal coordinates for Sputnik 1960 Epsilon, Cosmos XI, XVII, XXV, XXVI, XXVIII, Polet I and II, and Elektron I are presented based on observations from Soviet stations during April 1964 Transl. by K.W.

N67-29948 Academy of Sciences (USSR), Moscow. Astronomy Committee.
RESULTS OF OBSERVATIONS ON ARTIFICIAL EARTH SATELLITES, NO. 82
1966 44 p In RUSSIAN

Horizontal coordinates are presented in tabulated form for Sputnik 1960 Epsilon, Cosmos XVII, XXV, XXVI, XXXI, Polet I and II, and Elektron I as observed from Soviet stations during June 1964. Transl. by K.W.

N67-29949 Academy of Sciences (USSR), Moscow. Astronomy Committee.
RESULTS OF OBSERVATIONS ON ARTIFICIAL EARTH SATELLITES, NO. 81
1966 49 p In RUSSIAN

Presented are tables containing the equatorial coordinates for Sputnik 1960 Epsilon, Cosmos XVII, XXV, XXVI, XXXI, Polet I and II, and Elektron I as observed from Soviet stations during June 1964. Transl. by K.W.

N67-29977# Universidad Nacional de Columbia, Bogota. Facultad de Ciencias.
EPHEMERIS OF THE NATIONAL ASTRONOMICAL OBSERVATORY, 1967 [ANUARIO DEL OBSERVATORIO ASTRONOMICO NACIONAL, 1967]
Jul. 1966 104 p refs In SPANISH
CFSTI: HC $3.00/MF $0.65

Astronomical observatory data for 1967 are presented in tabular form. Listed are eclipses, sidereal time, sun, moon, planets, together with observation times for the sun and moon. Average positions of certain stars for 1967 and 1968 are also calculated. Transl. by R.U.

N67-29983* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ENVIRONMENT OF VENUS: A DISCUSSION OF ITS ATMOSPHERE AND SURFACE
Robert B. Owen, C. L. Hasseltine, William T. Roberts, George S. West, and Jeanette A. Sciesum 1 May 1967 142 p refs Supersedes NASA-TM-X-53327; see N65-35976
(NASA-TM-X-53497; NASA-TM-X-53327) CFSTI: $3.00 CSCL 03B

Presented is a self-consistent model atmosphere for the planet Venus, with emphasis on parameters of general use in developing vehicle design criteria. Kern and Schilling's program for generation of atmospheric parameter values is coupled with the most recent estimates of surface conditions in order to derive the atmosphere environment at different altitudes. A range of initial values is used to produce a parametric band most representative of actual conditions. Because of the extreme pressures and temperatures involved, it is felt that design for such an environment presents an engineering problem of the first magnitude. Author

N67-29986*# TRW Systems, Redondo Beach, Calif.
ANALYSIS OF INTEGRATION ERROR IN THE ODP-L PROGRAM AND THE EFFECT OF SELENOPOTENTIAL PARAMETERS ON THE SOLUTION VECTOR
M. R. Katz and P. A. Lavole 30 Jun. 1967 57 p refs
(Contract NAS1-4605-5)
(NASA-CR-66391; TRW-07987-6001-R000) CFSTI: HC $3.00/MF $0.65 CSCL 22C

An investigation into the ODP-L orbit determination program integration characteristics and the sensitivity of the solution vector to the coefficients of the lunar potential model is described. A reference lunar orbit trajectory was integrated on the ODP-L program at various fixed integration step sizes. Simulated range and range rate observations were computed from these reference trajectories. The error due to integration in the computation of the observables was fit to an equation that related the error and the step size. Subsequent evaluation of the coefficients of the equation for various cases revealed that this method of predicting the error due to integration could not be generalized and would involve cumbersome computations in order to calculate the biases for all observations in a typical tracking orbit determination. The ODP-L generated observations were input to the TRW AT-85 program to determine the bias in the solution vector introduced by the observation bias. Because of possible program incompatibilities, it has not been possible to evaluate the bias in the solution vector that is introduced by the ODP-L integration package. Author

N67-29989*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MACRO AND MICRO STRUCTURE OF THE INTERPLANETARY MAGNETIC FIELD
Leonard F. Burlaga and Norman F. Ness Jun. 1967 17 p refs Presented at the 10th Intern. Conf. on Cosmic Rays, Calgary, Alberta, Jun. 1967
(NASA-TM-X-55815; X-612-67-278) CSCL 03C

Detailed measurements of the interplanetary magnetic field were performed with an accuracy of ±.25γ on the Pioneer 6 satellite beginning towards the end of solar rotation 1811 and continuing into solar rotation 1817 in mid 1966. A nonstationary pattern to the sector structure was observed. The polarity autocorrelation function shows a peak at 29 days. A radial gradient of the interplanetary magnetic field between 0.81 and 1.0 AU was observed in agreement with Parker's model. The average magnitude of the component perpendicular to the ecliptic plane was zero. The direction of the interplanetary magnetic field was frequently observed to change by $\omega \geq 30°$ in less than 30 seconds as the field was carried past the spacecraft. In most cases the magnetic field intensity did not change significantly across the discontinuity. Several times, a large, discontinuous change in the field direction was accompanied by a dip in the field intensity. In each case, the measured minimum magnetic field intensity agreed with value which was calculated from the hypothesis that the dip was the result of magnetic field annihilation. Author

N67-29991*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE IRON METEORITES, THEIR THERMAL HISTORY, AND PARENT BODIES
Joseph I. Goldstein and James M. Short Jun. 1967 85 p refs
(NASA-TM-X-55814; X-641-67-274) CSCL 03B

Cooling rates are determined for the formation of the Widmanstatten pattern to obtain information on the number and possible types of parent meteorite bodies. About two thirds of the meteorites cooled between 1° and 10°C/m.y. although the total variation in cooling rates is 0.4° to 500°C per million years. These variations indicate that the iron meteorites formed in more than one parent body, the Midmanstatten pattern formed at low pressures, and the maximum sized parent body was about 300 km in radius if the irons formed in its core. Evidence is presented to show that meteorites, in the Ge–Ge groups are genetically related. Characteristic plessite structures were observed for each of these groups. The cooling rate variations in both Ge–Ge groups I and IIIb are small and independent of chemical composition. These meteorites probably formed in the cores of parent bodies about 200 km in radius. The cooling rate variations in both groups IIIa and IVa are large and vary with the Ni content, decreasing as the Ni content increases. These meteorites probably formed in isolated regions spread throughout parent bodies 150–200 km in radius. These regions consisted of molten metal at the time of formation. Author

N67-30015* Volt Technical Corp., Washington, D. C.
DISTRIBUTION OF MASSES IN GALAXIES ACCORDING TO DATA ON RADIAL VELOCITIES [RASPREDELENIYE MASS V GALAKTIKAKH PO DANNYM LUCHEVYKH SKOROSTEY]
V. S. Sizikov 17 May 1967 9 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 1, no. 1, 1967 p 137–143
(Contract NAS5-12487)
(NASA-CR-85240; ST-IGA-10607) CFSTI: $3.00 CSCL 03B

Two new ways are proposed for the solution of the Burbidge and Prendergast equation. The results of calculation of the mass for 12 galaxies and of the density for 4 galaxies are given. The tables and the diagrams presented show considerable departures from the results of other authors. Author

N67-30041* Volt Technical Corp., Washington, D. C.
REFLECTION FACTOR FROM THE PLANE-STRATIFIED MEDIUM OF LUNNITE FOR VARIOUS ANGLES OF INCIDENCE OF ELECTROMAGNETIC WAVES [KOEFFITSIENT OTRAZHENIYA OT POSKOSLOISTOY SREDY LUNITA DLYA RAZLICHNYKH UGLOV PADENIYA ELEKTROMAGNITNYKH VOLN]
Yu. G. Matveyev 6 Jun. 1967 9 p refs Transl. into ENGLISH from Astron. Zh. (USSR), v. 44, no. 2, 1967 p 419–425
(Contract NAS5-12487)
(NASA-CR-85265; ST-LPS-RWR-10619) CSCL 03A

The reflection factor from a nonuniform inhomogenous medium of plane-stratified nature is computed for the case when this medium's index of refraction varies from a certain value on the surface to another value in depth along the exponential curve. It is shown that the angular dependence of the reflection factor of such a medium coincides well with that of an homogenous medium for a certain effective value of the index of refraction, determined from the condition of equality of these media's reflections factors when the incidence of electromagnetic waves is normal. Inasmuch as the reflection factor of a stratified medium is dependent on wavelength, the effective reflection factor is also a function of γ. An approximation is obtained of the frequency dependence of the effective index of refraction as a function of inhomogeneity depth. The applicability is concluded of Fresnel formulas for the calculation of integral Moon's radioemission regardless of the existence of well known inhomogeneity of properties in depth. Author

N67-30072*# Lincoln Lab., Mass. Inst. of Tech., Lexington.
RADAR STUDIES OF THE MOON Quarterly Progress Report, Period Ending 15 May 1967
P. B. Sebring 31 May 1967 15 p refs
(Contract NSR-22-009-108)
(NASA-CR-85256; QPR-2) CSCL 03A

Described is the progress in high resolution reflective mapping at 3.8 cm. Most of the area within 10° of the lunar equator has been observed, and much of the data have been converted to intensity maps. Discussed are some further studies and limitations of the supersynthesis technique, including systematic and random errors. These studies are to serve primarily for future polarization studies at 23-cm wavelength. Assembly, improvement, and operation of the 8-mm radar observation system are also discussed. K.W.

N67-30077* California Univ., San Diego.
PART I: HIGH TEMPERATURE EQUILIBRIA AND CONDENSATION. PART II: SOLAR WIND INTERACTION WITH SOLIDS
Harry Chester Lord, III (Ph.D. Thesis) 1967 160 p refs
(Grant NsG-321)
(NASA-CR-85260) CSCL 04A

Presented first is a study of the molecular equilibria in a gas cloud with cosmic elemental abundances, temperatures of 2000°K or 1700°K, and total pressures of approximately 1 atm. and 5×10^{-4} atm. with special consideration of the formation of a condensed phase. From some 150 species considered, Al_2O_3, HfO_2 W, ZrO_2 and $MgAl_2O_4$ are found to condense at 2000°K at a total pressure of 1 atm. Decreasing the temperature or increasing the pressure condenses more species, which in general are of complex structure. In the atmospheres of cool stars polyatomic molecules and possibly condensed species play an important role. The calculated equilibria should be useful for spectral studies, and the order and type of condensates should prove helpful in cosmochemical problems. In the second part of this work, the effects of solar wind are simulated by irradiating olivine with 2 keV protons, and olivine, dunite, enstatite, and fayalite were irradiated with 1.8 keV He ions. Both the hydrogen and helium are quantitatively retained as the lowest integrated fluxes used ($\approx5\times10^{16}$ ions/cm^2). Decreased retention with increasing integrated flux is observed. X-ray diffraction analysis, electron probe microanalysis, microscopic analysis, and studies of X-rays produced by the low energy protons were performed on the bombarded surfaces. Author

N67-30086 Royal Observatory, Edinburgh (Scotland).
THE CHEMICAL COMPOSITION OF THE MANGANESE STAR 53 TAURI
B. N. G. Guthrie HMSO, [1966] 19 p refs *Its* Publ. Vol. 5, No. 9 p 181–194
HMSO: 5s 6d

The chemical composition of the atmosphere of 53 Tau is determined by a differential curve-of-growth method with α Lyr as the comparison star. Groups of lines of similar mean excitation and ionization potentials and wavelengths are used so that the results will not be seriously affected by abnormalities in the structure of 53 Tau. Manganese is overabundant, while iron and magnesium are deficient. Calcium and scandium are also deficient as in metallic-line stars. A consideration of the Balmer Lines, the intrinsic color index $(B-V)_0$, 53 Tau is abnormal, possibly due to the presence of a close companion star of lower luminosity. Author

N67-30087 Royal Greenwich Observatory, Herstmonceux (England).
STUDIES OF THE GLOBULAR CLUSTER ω CENTAURI. V: HR DIAGRAM, STRUCTURE AND DYNAMICS
R. J. Dickens and Richard Woolley London, HMSO, 1967 79 p refs *Its* Roy. Obs. Bull. No. 128
HMSO: 10s 6d

Some results of an extensive photometric and astrometric program on the globular cluster ω Centauri are described. The color magnitude diagram for stars brighter than about $M_v=+2^m$ is presented. The cluster is typical of clusters with extremely weak metal lines in their spectra (e.g. M15, M92), in having a strong blue population of the horizontal branch, with very few stars to the red side of the variable gap. A detailed analysis of the distribution of stars with radius and position angle is given. The results show that, with the exception of the RR Lyrae variable stars, there is little difference between the radial distributions of stars in different parts of the HR diagram outside a radius of about 7 parsecs. Author

N67-30107# Royal Astronomical Society, London (England).
A SURVEY OF RADIO SOURCES IN THE DECLINATION RANGES −07° TO 20° AND 40° TO 80°
J. F. R. Gower, P. F. Scott, and D. Wills 1966 97 p refs

The results of a survey of radio sources in the ranges of declination −07° to +20° and +40° to +80° using the large Cambridge interferometer at 178 Mc/s are presented. The methods of observation and reduction are described briefly. The catalogue lists the position and flux densities of 3624 sources having $S\geq2\pm10^{-26}$ w.m^{-2} (c/s)$^{-1}$ at 178 Mc/s. Author

N67-30145*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MAXIMUM POSSIBLE ERROR IN POSITION IN A LEAST SQUARE ORBIT
R. G. Langebartel Feb. 1967 45 p refs
(NASA-TM-X-55820; X-507-67-43) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A second order theory is developed for the problem of determining the maximum possible error in position if a Keplerian orbit is fitted by least squares to a set of observational data under the condition that the sum of the squares of the distances between the true and observed positions be held constant. A result of the first order theory is that the maximum error at any one position in the orbit occurs when the observed positions coincide with the least squares computed positions. This doesn't remain true in the second order theory. Application of the second order theory is made in detail to the case of circular orbits. Author

N67-30158*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTRODUCTION TO THE THEORY OF FLIGHT OF ARTIFICIAL EARTH SATELLITES
P. E. El'yasberg 1967 356 p refs Transl. into ENGLISH of the book "Vvedenie v Teoriyu Poleta Iskusstvennykh Sputnikov Zemli" Moscow, Izd. Nauka, 1965 Published for NASA and NSF
(NASA-TT-F-391; TT-67-51399) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A systematic treatment is given to the fundamental propositions involved in the flight mechanics of artificial earth satellites, with emphasis on the general rules governing the coast of a satellite with its engines turned off. Problems concerned with the motion of a satellite in circular and nearly circular orbits, analyzing the alternative trajectories through two given points in space, the effect of initial firing conditions on the elements of an elliptical orbit, the effect of the earth's flattening and aerodynamic drag on satellite motion, and the effect of lunisolar perturbations on satellite orbits. Emphasis is on the motion of satellites in circular and nearly circular orbits as these are highly significant in the actual practice of satellite launching. The results obtained for these orbits are both simple and visual, and greatly contribute to the overall understanding of the general laws of satellite motion. R.N.A.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-29025*# LTV Aerospace Corp., Dallas, Tex.
FEASIBILITY, PARAMETRIC DESIGN, AND COMPARATIVE ANALYSIS OF AN UNGUIDED SOLID FUEL ROCKET VEHICLE WITH SOLAR ORBIT, EARTH PROBE, AND RE-ENTRY MISSION CAPABILITIES

T. C. Walker Washington, NASA, May 1967 158 p refs
(Contract NAS1-5539)
(NASA-CR-753) CFSTI: $3.00 CSCL 22B

An investigation to show the feasibility of orbiting a payload about the sun with an unguided solid fuel rocket vehicle was conducted. An approximate simulation technique was developed for the trans-solar trajectory. Forty-four candidate launch vehicle configurations, composed of existing or development hardware, were formulated for study. After the elimination of all but six candidate configurations, preliminary vehicle performance and launch opportunities were evaluated for each of the prospective vehicles. Based on technical, reliability, and cost considerations, a four stage launch vehicle configuration (428A) was recommended. The motors for this configuration were Algol IIB, X-259, 23KS11000, and BE-3, with two TX-77-13's for first stage thrust augmentation. The selected 428A vehicle was evaluated from the standpoint of solar trajectory performance and preliminary configurational design. Author

N67-29029*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
EVALUATION OF LATERAL-DIRECTIONAL HANDLING QUALITIES OF PILOTED RE-ENTRY VEHICLES UTILIZING FIXED-BASE AND IN-FLIGHT EVALUATIONS
J. I. Meeker Washington, NASA, May 1967 189 p refs
(NASA Order E-20812; Contract AF 33(615)-1253)
(NASA-CR-778) CFSTI: $3.00 CSCL 22C

The final results of a fixed-base and in-flight research program to investigate lateral-directional handling qualities in the re-entry mission are reported and discussed. Most evaluations were for the up-and-away phase of the re-entry mission, but a small number of configurations were evaluated in a spiral descent to a landing approach. Three different groups of lateral-directional flight characteristics were investigated and the results are presented. Evaluation configurations were selected from a previous re-entry vehicle evaluation program and later configuration designs were based on a general lateral-directional handling qualities investigation conducted. Other configurations were directly applicable to lifting body investigations. All of the configurations were evaluated for their suitability to the re-entry mission. The vehicle used for both the fixed-base and in-flight simulations was a three-axis variable stability T-33 airplane. Author

N67-29030*# General Technologies Corp., Alexandria, Va.
INVESTIGATION OF THREE CLASSES OF COMPOSITE MATERIALS FOR SPACE VEHICLE APPLICATION
John A. Alexander, J. C. Withers, and B. A. Macklin Washington, NASA, May 1967 99 p refs
(Contract NASw-1347)
(NASA-CR-785) CFSTI: HC $3.00/MF $0.65 CSCL 11D

Fabrication, development and characterization was conducted on continuous filament, reinforced whisker reinforced and multilaminar composites. Four techniques for continuous filament composite formation were investigated: electrodeposition with concurrent filament winding, the hot pressure bonding of electrolytically deposited monolayer tapes, the hot pressure bonding of foil filament arrays and liquid metal infiltration. The tensile, compressive and flexure properties of W–Ni, B–Al and B–Mg composites are compared. The best compressive and flexure strength results were at least double the tensile values while compressive and flexure moduli were quite low. A technique for the accomplishment of aligned whisker yarns by dry spinning textile techniques and the subsequent infiltration of aligned whisker arrays by electrodeposition yielded composite samples with strengths ranging between 228×10^3 psi and 327×10^3 psi, which calculate to whisker strength utilization in excess of one million psi. The feasibility of high volume production of infiltrated aligned whisker wires by a combination of textiling and continuous electroplating technology is clearly demonstrated. Deposition techniques for the formation of multilaminar Mo–TiB_2 composites have been developed which yield good interphase bonding. Author

N67-29035*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
DEVELOPMENT AND QUALIFICATION OF GEMINI ESCAPE SYSTEM
Hilary A. Ray, Jr. and Frederick T. Burns Washington, NASA, Jun. 1967 80 p
(NASA-TN-D-4031) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Presented is a summary of the development and qualification of the escape system incorporated in the Gemini spacecraft. This system provides a positive means of crew escape over a wide range of conditions. Escape can be effected from conditions of pad aborts at zero velocity to altitudes in excess of 40,000 feet at velocities in excess of 1600 feet per second. Significant tests and results are presented in the report sections on development and qualification testing. Author

N67-29380*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC STABILITY INVESTIGATION OF A SOUNDING-ROCKET VEHICLE AT MACH NUMBERS FROM 1.50 TO 4.63
C. Donald Babb and Dennis E. Fuller Washington, NASA, Jun. 1967 78 p ref
(NASA-TN-D-4014) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A single-stage sounding rocket vehicle was tested in a wind tunnel to determine the effect of body length and fin cant. Tests were performed through an angle-of-attack range from about $-4°$ to $20°$ and for angles of sideslip from about $-4°$ to $8°$. Mach number varied from 1.50 to 4.63 and all tests were made at a Reynolds number per foot of 3.0×10^6 (9.84×10^6 per meter). Two vehicles with length-to-diameter ratios of 18.20 and 23.77 were tested with tail fins off and with fins on at cant angles of $0°$ and $2°$. The configuration with either a short or a long body had a rather severe pitch-up at moderately low angles of attack. Center of pressure moved forward with increasing Mach number for either vehicle configuration, with the variation somewhat greater for the longer vehicle. Each configuration indicated large values of rolling moment due to sideslip, particularly at the lower Mach numbers and higher angles of attack. A progressive decrease in directional stability with increasing angle of attack and Mach number was found, with the decrease somewhat greater for the long configuration. The canted fins were effective in producing roll throughout the Mach number and angle-of-attack ranges. Author

N67-29389*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
FLIGHT TEST AERODYNAMIC HEATING DATA FOR THE AFTERBODY OF THE PROJECT MERCURY SPACECRAFT WITH COMPARISONS TO AVAILABLE PREDICTION METHODS
J. D. Murphy Washington, NASA, Jun. 1967 130 p refs
(Contract NAS9-3531)
(NASA-CR-849) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Afterbody heating experienced by the Project Mercury spacecraft during reentry is determined from skin temperature measurements obtained in four flights. Measured skin temperature histories and inferred heating rate histories are presented in tabular and graphical form. Dimensionless heat transfer parameters are computed and compared with the theoretical predictions. It is found that the laminar data can be correlated by an expression of the form $St \sim Re_L^{-3/4}$. The flight test data is in good agreement with the above correlation for Reynolds numbers based on wetted length less than 2×10^6. For Reynolds numbers larger than 2×10^6 the experimental data gives strong indication of transitional flow. Author

N67-29379*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC STABILITY INVESTIGATION OF A SINGLE-STAGE SOUNDING ROCKET AT MACH NUMBERS FROM 0.60 TO 1.20

James C. Ferris Washington, NASA, Jun. 1967 63 p refs
(NASA-TN-D-4013) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Tests were conducted on a 1/2-scale model of a single-stage meteorological sounding rocket to determine the effect of body length and fin cant angle on the aerodynamic characteristics of the model. Tests were conducted through an angle-of-attack range from −3° to 21° at fin roll angles of 0°, 22.5°, and 45°. The Mach number was varied from 0.60 to 1.20 with a constant Reynolds number of 9.8×10^6 per meter (3.0×10^6 per foot). Tests were made for two models with fineness ratios of 18.2 and 23.8. Results were obtained with fins off and with fins on at cant angles of 0° and 2°. The models had similar pitch-up tendencies in the angle-of-attack range from approximately 8° to 16° at all Mach numbers. Both models had large yawing moments at the high angles of attack. The canted fins produced positive rolling moments through the angle-of-attack range from −4° to 12° at all Mach numbers, and this improved the longitudinal stability of the short model in the angle-of-attack range from −2° to 2°. Author

N67-29431*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PRELIMINARY INVESTIGATIONS TO DETERMINE NUCLEAR-ELECTRIC SPACECRAFT CONFIGURATIONS FOR HIGH-ENERGY MISSIONS
J. J. Volkoff and J. R. Womack 15 Jun. 1967 22 p refs
(Contract NAS7-100)
(NASA-CR-84998; JPL-TR-32-1085) CFSTI: HC $3.00/MF $0.65 CSCL 22B

This study determines how the mass of spacecraft systems is affected by changes in spacecraft configuration for a conceptual 300-kwe nuclear-electric spacecraft designed for a Jupiter orbital mission. The power plant employed a reactor-turbo-generator system. The nuclear-radiation shield, heat-rejection radiators, spacecraft structure, booster-spacecraft adapter, and aerodynamic shroud are considered as subsystems most likely to vary appreciably in mass with changes of spacecraft configuration. The two selected spacecraft configuration concepts feature the heat rejection radiator systems assembled in the flat plane configuration and the cylindrical configuration. The flat plane radiator configuration was found to be the more favorable concept. Author

N67-29459# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
MOMENTUM TRANSFER AS A MEANS OF DESPINNING A ROTATING SPACECRAFT
James F. Smola Jan. 1967 47 p
(Contract NOw-62-0604-c)
(TG-885; AD-851004) CFSTI: HC $3.00/MF $0.65

The angular rate of a rotating spacecraft can be reduced by transferring momentum from the spacecraft body to a pair of masses attached to cables wrapped around it. The cables unwind and retard spin with a counteracting couple. Under the proper conditions, spin can be reduced to zero; this is found to be independent of initial spin rate. Detaching the cables at this instant leaves the spacecraft motionless. Residual spin due to tolerance accumulation can be minimized by releasing cables when radial rather than tangent to the spacecraft. Author (TAB)

N67-29578# Advisory Group for Aerospace Research and Development, Paris (France).
THE USE OF WIND SHEARS IN THE DESIGN OF AEROSPACE VEHICLES
Robert S. Ryan (NASA, Marshall Space Flight Center) and James R. Scoggins Oct. 1966 45 p refs Presented at the 23rd Meeting of the AGARD Struct. and Mater. Panel, Paris, 4–11 Oct. 1966
(AGARD-546)

The relative influence of various wind profile properties and disturbances on launch vehicle flight dynamic response is studied. Particular emphasis is placed on the influence of wind shears and turbulence on dynamic response during the boost phase of the flight. Four hundred and seven individual detailed (Jimsphere) wind profiles are the primary wind inputs for this analysis. Time response of the vehicle to each profile is computed and a statistical evaluation of the results made. Results are obtained for the Saturn V space vehicle and conclusions drawn as to the relative influence of wind shears and turbulence versus the degree of refinement of the dynamic model of the space vehicle. Author

N67-29697*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
REPORT ON THE DEVELOPMENT OF THE MANNED ORBITAL RESEARCH LABORATORY (MORL) SYSTEM UTILIZATION POTENTIAL. TASK AREA III: MORL CONCEPT RESPONSIVENESS ANALYSIS. BOOK 1
N. Kallay Nov. 1965 325 p refs
(Contract NAS1-3612)
(NASA-CR-66286; SM-48813) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An analysis was conducted to determine the ability of the proposed Manned Orbital Research Laboratory (MORL) to fulfill the requirements of the mission development plans. The basic mission requirements were listed, and the results of studies in each area were discussed in detail. The adequacy of MORL resources and the demands expected to be made on MORL subsystems were investigated. Alternate MORL missions were considered and the required changes to the base line MORL design to accommodate these missions were given. Appended are descriptions of computer programs for evaluating systems effectiveness and the assimilation of radio biological data. H.S.W.

N67-29684*# Martin Co., Baltimore, Md.
STUDY OF THE INFLUENCE OF SIZE OF A MANNED LIFTING BODY ENTRY VEHICLE ON RESEARCH POTENTIAL AND COST. PART VI: RESEARCH VEHICLE SIZE SELECTION AND PROGRAM DEFINITION Final Report
James McCown et al May 1967 89 p refs
(Contract NAS1-6209)
(NASA-CR-66357) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Planning data is provided for assessing the utility and cost of an entry flight research program, and descriptions are given of the cost and effectiveness analyses which form a basis for selecting the optimum vehicle size, number of crew, and flight plan. Two flight loading models, one heuristic and the other computerized, are developed to evaluate the research potential of candidate vehicle and flight plan combinations. Effectiveness is measured and optimized in terms of value of research performed. Cost estimates for the candidate vehicle and program combinations are developed from two mathematical cost analysis models based on historical program cost data. With the selected vehicle, a cost range for programs of 7 to 11 flights is estimated to be $853 to $1003 million. The selected D/3 vehicle is found to have the highest research value per unit cost and the lowest cost per unit of payload weight in orbit. This vehicle, which performs the maximum number of tasks assigned, also satisfies criteria for landing visibility, experiment packing density, rendezvous and docking adaptability and operational adaptability. Author

N67-29985*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME I: SHORT PERIOD DYNAMICS
Arthur L. Greensite Washington, NASA, Jul. 1967 55 p refs
(Contract NAS8-11494)
(NASA-CR-820; GD/C-DDE65-055) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The use of perturbation equations to analyze the short period dynamics in a space launch vehicle is considered. The perturbation equations are derived taking into account such factors as center of gravity eccentricity, bending, propellant sloshing, and engine inertia. The approach taken in deriving the motion equations of the space launch vehicle involves the derivation of artificially

uncoupled motions in which the coupling terms appear via appropriately introduced mathematical constraints. Using this approach, procedures are recommended for the following: rigid body equations, equations for elastic vibrations, forces and moments, complete equations of perturbed motion, and simplified transfer functions. L.E.W.

N67-29997*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SYSTEM SAFETY HANDBOOK
6 Jan. 1967 31 p Prepared by Boeing Co.
(Contract NAS8-5608)
(NASA-TM-X-53563) CSCL 13L

The manual describes the typical problem areas and equipment within the Saturn system requiring special attention for the reduction or elimination of hazards during testing, maintenance, and operation. The procedures are outlined for determining that the required conditions exist during the performance of the test program, and the test participation, failure analysis, and accident/incident investigation aspects are described. The systems requirements are listed for the electrical, pneumatic, liquids, hydraulic, transporting and handling, and ordnance systems. N.E.N.

N67-29998*# National Aeronautics and Space Administration, Washington, D. C.
SPACE-CABIN ATMOSPHERES. PART IV: . ENGINEERING TRADEOFFS OF ONE- VERSUS TWO-GAS SYSTEMS
Emanuel M. Roth 1967 138 p refs
(NASA-SP-118) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The physiological considerations which set boundaries for the physical environment within the cabin are evaluated. The engineering analysis is a review of the interaction between the physiological and hardware parameters of the environmental control system. An attempt is made to compare for each subsystem the effect of several physiologically acceptable gas mixtures on the weight and power penalties for missions of different types and durations. The tradeoff criteria are used in an analysis of a typical mission—a two-man orbiting vehicle. The results of tradeoff analyses performed by several groups are compared to demonstrate the sensitivity of the final product to the physical, physiological, and engineering assumptions which were made. This mission was chosen only because of the availability of several completely independent studies of the tradeoffs by the aerospace industry. These independent analyses offer the opportunity for evaluation of assumptions and biases which usually creep into any tradeoff study. Author

N67-30023# Martin Co., Baltimore, Md.
STUDY OF THE INFLUENCE OF SIZE OF A MANNED LIFTING BODY ENTRY VEHICLE ON RESEARCH POTENTIAL AND COST. PART I: SUMMARY Final Report
May 1967 24 p
(Contract NAS1-6209)
(NASA-CR-66352; ER-14471-1) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Specific research tasks for candidate entry vehicle designs are defined. The study concentrates on the HL-10 manned lifting body entry vehicle. Parametric cost estimates, vehicle and crew size selection, flight operations, and design data used for determining the parameters needed for optimizing future missions employing lifting entry, are presented. Recommendations are made. L.S.

N67-30024*# Martin Co., Baltimore, Md.
STUDY OF THE INFLUENCE OF SIZE OF A MANNED LIFTING BODY ENTRY VEHICLE ON RESEARCH POTENTIAL AND COST. PART II: RESEARCH PROGRAM EXPERIMENTS Final Report
May 1967 295 p refs
(Contract NAS1-6209)
(NASA-CR-66353; ER-14471-2) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Research tasks for an entry research program were identified. Requirements for the earth entry of a medium L/D jilting body entry body, the HL-10, returning from near earth missions were analyzed. In analyzing cost and effectiveness, a technique was developed for assigning the research tasks to flights of a specified flight plan. Requirements of each research task (such as weight of equipment, number of crewmen, and type and number of entry conditions to be flown) were established. The research tasks were used in support justification for a manned flight research program. L.S.

N67-30031*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE INFLUENTIAL ASPECTS OF ATMOSPHERIC DISTURBANCES ON SPACE VEHICLE DESIGN USING STATISTICAL APPROACHES FOR ANALYSIS
Robert S. Ryan and Alberta W. King 13 Jan. 1967 122 p refs
(NASA-TM-X-53565) CSCL 22D

The influential aspects of various wind profile disturbances on the dynamic response of the vehicle are considered. Particular emphasis is given to separating the influence of wind shears, turbulence and quasi-steady wind speed on the dynamic response during the boost phase of flight. Four hundred and seven individual detailed (Jimsphere) wind profiles are the primary wind inputs, although the MSFC synthetic profile is also discussed. The time response to each profile is run and a statistical analysis is made. Severe profiles are ranked in terms of the bending moment at two vehicle stations for the Saturn V vehicle. The influence of results on vehicle design and flight operational procedures is determined. Author

N67-30128*# National Aeronautics and Space Administration. Manned Spacecraft Center, Langley Station, Va.
AERODYNAMIC STABILITY CHARACTERISTICS OF THE APOLLO LAUNCH ESCAPE VEHICLE
William C. Moseley, Jr. and James G. Hondros Washington, NASA, Jun. 1967 131 p refs
(NASA-TN-D-3984) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A program of wind tunnel tests was conducted to determine the static and dynamic stability of the Apollo launch escape vehicle. Static stability studies included the effects of escape rocket firing. Results of static tests showed that the vehicle was stable in the normal angle of attack operating range and that rocket thrusting generally decreased the longitudinal stability at all Mach numbers tested. Dynamic test data indicated that the vehicle had positive damping over the normal angle of attack operating range except for a very small angle range (±2°) near the trim angle of attack at subsonic speeds. Author

N67-30129*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME VIII: RENDEZVOUS AND DOCKING
Daniel Chiarappa Washington, NASA, Jul. 1967 62 p refs
(Contract NAS8-11494)
(NASA-CR-827; GD/C-DDE66-027) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Spacecraft control during the orbital rendezvous and docking phases is discussed with special attention to Gemini and the lunar excursion module. Launch-to-rendezvous is treated briefly to identify basic constraints affecting spacecraft design (mostly orbit parameters). Guidance system discussion is restricted to a description of software in the control diagrams. Rendezvous guidance/control is discussed with respect to midcourse and terminal guidance. Illustrations are presented for rendezvous and docking integrated control system design. Visual docking aids, and propulsion system configuration and sizing, are also considered. Finally two-body equations of motion are presented for the system. S.P.

N67-30130*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME F: SENSITIVITY THEORY
Arthur L. Greensite Washington, NASA, Jul. 1967 81 p refs
(Contract NAS8-11494)
(NASA-CR-824; GD/C-DDE66-030) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The theory of sensitivity is discussed with respect to design of space vehicle flight control systems. The sensitivity theory is concerned with determining the effects of parameter variations on system performance in a broad sense. It involves the usual frequency-response methods for single-input/single-output systems, as well as state-variable representations and samples data, and multivariable and optimal control systems. System transfer function, closed-loop poles, eigenvalues and eigenvectors, sampled-data and multivariable systems are considered as factors in measures of sensitivity. A design method for feedback system compensation is discussed, and the concept of "sensitivity in the large" is introduced to show that a suitably compensated high gain system exhibits the features generally thought to be obtainable only by adaptive methods. S.P.

N67-30131*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME II: TRAJECTORY EQUATIONS
Arthur L. Greensite Washington, NASA, Jul. 1967 101 p refs
(Contract NAS8-11494)
(NASA-CR-821; GD/C-DDE65-058) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Long-period dynamics of a vehicle that determine its capability to accomplish a specific mission are discussed. Trajectory equations and the relationship between guidance philosophy, control response, and trajectory profile are all considered as factors. A set of equations is presented that describes the motion of a spacecraft from launch to either earth impact or orbit injection. Significant effects for purposes of guidance and control, such as nonspherical rotating earth, variable mass of vehicle, eccentric c.g., and jet damping, are described. The emphasis is on launch trajectories rather than orbital mechanics. Additional data is presented for time rate of change of linear and angular momentum for variable mass systems, relations for the inertia dyadic, rocket engine thrust geophysical constants. S.P.

N67-30132*# General Dynamics/Convair, San Diego, Calif.
ANALYSIS AND DESIGN OF SPACE VEHICLE FLIGHT CONTROL SYSTEMS. VOLUME X: MAN IN THE LOOP
Richard M. Smith Washington, NASA, Jul. 1967 28 p refs
(Contract NAS8-11494)
(NASA-CR-829; GD/C-DDE66-023) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Two general scientific approaches for considering man as part of a control loop are described. The general approaches considered involve the: (1) development of transfer functions to express control relationships; and (2) simulation of system dynamics and environment; and evaluation of operator performance. Also discussed are recommended procedures for placing man in the control loop of boosters which consider the use of both of the prescribed techniques. S.C.W.

N67-30142*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TUBE-LAUNCHED ROCKET PERFORMANCE
William C. Strack Washington, NASA, 1967 21 p refs
(NASA-TM-X-52328) CSCL 22D

Imparting an initial velocity to rocket vehicles using an ejection tube can result in significant performance gains. Curves are presented that show orbital payload and ballistic range increases as a function of tube muzzle velocity and tube length. Results are shown for both fixed-design vehicles and a "rubber-design" hypothetical three-stage solid propellant vehicle. The "rubber-design" vehicle is optimally staged to take maximum advantage of tube launching. The gains are proportional to the so-called gravity losses of the conventional launch case. Gains are higher for low-performance vehicles rather than high-performance vehicles. Chemical rocket payload gains of 13% are possible with 500-ft. long tubes. For future rockets with 15 g peak ejection load capabilities, the gain could be as high as 21% greater than conventional launches. For high thrust-to-weight ratio rockets, the launch tube must be inclined away from the vertical to realize the full performance potential. The peak dynamic pressure and heating rate are less for tube launches than conventional launches for most muzzle velocities. Author

N67-30146* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLAR-ELECTRIC PROPULSION PROBES FOR EXPLORING THE SOLAR SYSTEM
William C. Strack and C. L. Zola Washington, NASA, 1967 20 p refs
(NASA-TM-X-52318) CSCL 21C

A limited study is made for unmanned probe spacecraft using solar-electric propulsion. Flyby and orbiter payloads of 500, 1000, and 2000 pounds are arbitrarily picked and delivered to all the planets and close-in solar orbits. A current technology solar cell powerplant of 75 lb/KW_e and existing electric ion thrustors are assumed for the electric spacecraft. Three different size chemical propulsion launch vehicles are used to boost the spacecraft to Earth escape velocity or higher at the start of each mission. A few planetary swingby cases are included for the electric spacecraft. Charts are given to show the minimum trip times for each booster/payload combination. Small chemical launch vehicles in conjunction with solar-electric spacecraft can perform many missions better than larger chemical launch systems used alone. Advantages are greatest for missions that aim to capture a payload in an orbit about the target planet. Author

N67-30150*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE DECREASE OF THE RADAR CROSS SECTION OF THE APOLLO COMMAND MODULE DUE TO REENTRY PLASMA EFFECTS
John W. Marini Jun. 1967 23 p refs
(NASA-TM-X-55824; X-507-67-283) CFSTI: HC $3.00/MF $0.65 CSCL 22C

During reentry, the radar cross section of a space vehicle may decrease due to a number of effects associated with the plasma sheath. The decreases occur at certain combinations of altitude and speed. In this report, some regions of decrease are determined for the case of the Apollo Command Module approaching a C-band radar. Author

N67-30163*# Lockheed-California Co., Burbank.
AN INTRODUCTION TO SPACECRAFT THERMAL CONTROL
B. A. Nevelli, H. D. Schultz, F. L. Guard, P. S. Hirasawa, I. Shuldiner et al 10 Aug. 1965 469 p refs
(Contract NAS9-3349)
(NASA-CR-65580; LR-18901) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Problems associated with external and internal passive and active methods of spacecraft thermal control are discussed. Analytical procedures required to perform a transient heat transfer and thermodynamic analysis of a space vehicle are described. Included are thermophysical properties of various structural and insulating materials, fluid thermodynamic properties, and surface finish radiative properties. Also discussed are the effects of the spacecraft environment on the thermal control materials. L.S.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-28999# Watervliet Arsenal, N. Y. Benet Labs.
VIBRATION OF MULTI-LAYERED ANISOTROPIC CYLINDRICAL SHELLS
Vincent X. Kunukkasseril Feb. 1967 56 p refs
(WVT-6717; AD-649662) CFSTI: HC $3.00/MF $0.65

A study on the vibration of multi-layered anisotropic cylindrical shells is presented on the basis of Kirchhoff-Love theory of thin shells. The displacement equations of motion for multi-layered shells with layers having one plane of elastic symmetry parallel to the reference surface are developed. These equations are subsequently used to investigate flexural and extensional vibration of infinite and finite shells with anisotropic layers. Frequency equations for inextensional vibration of layered anisotropic shells are obtained by considering the kinetic and potential energies of the vibrating shell. Also, it is shown that the equations of the layered shell can be reduced to the case of a single layer helically stiffened shell. Numerical examples are considered for illustrating the significance of various types of vibration, as well as to show the effect of rotation of principal axes of stiffness of the layers on the frequencies. Frequencies for various types of vibration of a 3-layered shell and for helically stiffened shell are presented in the form of curves and tables. Author (TAB)

N67-29009*# Scientific Translation Service, La Canada, Calif.
THE VIBRATION MODES AND EIGENFREQUENCIES OF CONICAL (AND CYLINDRICAL) SHELLS
Chao-tsien Tang Washington, NASA, Jun. 1967 27 p refs
Transl. into ENGLISH from Acta Mech. Sinica (Communist China), v. 6, no. 2, 1963 p 133–151
(Contract NASw-1496)
(NASA-TT-F-11017) CFSTI: HC $3.00/MF $0.65 CSCL 20K

An exact solution of vibration modes and transverse eigenfrequencies of conical shells is studied. Donnell type differential equations with variable coefficients are used, neglecting the tangential components of inertia force. In order to reduce the computing effort, a simplified method is recommended. When vibrating, the elastic restoring effects in the shell due to membrane extensional forces and bending (and twisting) moments are regarded as two springs in parallel. Then this element of shell is equivalent to the parallel springs system with single degree of freedom, and the whole shell can be represented by the sum of infinite systems of this single type, where the stiffnesses of springs are functions of the coordinates. The analytical method presented in this paper can be used for shells with arbitrary conical angle α and various boundary conditions (the conditions at the vertex point of complete conical shell are discussed.) Author

N67-29026*# Michigan Univ., Ann Arbor.
AN EXPERIMENTAL STUDY OF PRESSURE DISTRIBUTION CURVES APPLICABLE TO PNEUMATIC TIRES
S. K. Clark Washington, NASA, May 1967 170 p refs
(Grant NsG-344)
(NASA-CR-754) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The object of this experimental work was to identify the various factors which make up and influence the total pressure distribution of a pneumatic tire in the fore-and-aft direction. By implication, these same factors cause variations in pressure across the width in a real tire. These factors have been identified as follows: (a) the inflation pressure inside the tire; (b) bending of the tire carcass in the tread region; (c) concentrated forces, appearing as sharp pressure distribution "spikes," occurring at the forward and aft ends of the contact patch, directly proportional to the bending rigidity of the carcass structure in the tread region, and associated with the so-called shear discontinuity of the carcass; (d) the outer covering, or tread of the tire considerably softer than the carcass structure itself; (e) large tire deflections tending to cause some buckling of the carcass near the center of the contact patch. Author

N67-29047# California Univ., Berkeley. Div. of Applied Mechanics.
ON OBTAINING SOLUTIONS IN NONLINEAR VISCOELASTICITY
R. M. Christensen Oct. 1966 28 p refs
(Contract Nonr-222(69))
(AM-66-15; AD-651183) CFSTI: HC $3.00/MF $0.65

A derivation is given of a particular form of the isothermal nonlinear stress constitutive relation for materials with fading memory. This particular derivation results in a form for the constitutive relations that is well suited for application in solving boundary-value problems. The resulting forms are applied to obtain the exact solution for the torsion of a right circular isotropic viscoelastic cylinder. Several effects due to the nonlinearity of the problem are discussed. Author (TAB)

N67-29056# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
NUMERICAL SOLUTIONS OF AXISYMMETRIC THERMAL STRESS PROBLEMS
G. Dalley Nov. 1966 57 p refs
(Contract NOw-62-0604-c)
(TG-876; AD-650388) CFSTI: HC $3.00/MF $0.65

A computer program was written to work thermal stress problems in right circular cylinders by finite-differences. This program was used to work several example problems, and to determine the best method of solution of the finite-difference equations. It is proposed that this method be extended to more general axisymmetric shapes. TAB

N67-29059# Illinois Univ., Urbana.
THE PLASTIC RESPONSE OF SOLIDS
John J. Gilman 28 Apr. 1967 40 p refs Presented at the Battelle Colloq. on Dislocation Dyn., Seattle, 1–8 May 1967
(Contracts AT(11-1)-1198; Nonr-3985(06); Grant DA-ARO(D)-31-124-G873)
(AD-651153) CFSTI: HC $3.00/MF $0.65

Past developments of the micro-dynamical description of plastic flow are outlined, and the successes of the theory are mentioned. Then some extensions in scope are suggested and discussed. These include: application to polymeric solids, collective dislocation behavior, and dynamics of precipitation hardening. The difficulty that the flowing-state differs from the post-flowing-state is emphasized. It is proposed that dislocation lines exist in noncrystalline solids and provide a convenient description for local shear correlations. The possibility that flutter is induced in moving dislocations by turbulent phonon-gas flow is considered. Finally, an atomic model for dislocation mobility in covalent crystals is presented. Author (TAB)

N67-29064# California Univ., Berkeley. Structural Engineering Lab.
BEHAVIOR OF COMPRESSIVELY LOADED REINFORCING WIRES
Leonard R. Herrmann, William E. Mason, and S. T. K. Chen (Calif. Univ., Davis) Jan. 1967 49 p refs Prepared for Stanford Res. Inst., Menlo Park, Calif.
(Contract N123(60530)55641A)
(SEL-67-2; AD-650617) CFSTI: HC $3.00/MF $0.65

A theoretical investigation of the compressive response of a wire embedded in a matrix is reported. In the first two sections consideration is given to the beam-column behavior of an initially crooked wire embedded in a matrix which is subjected to a state of uniaxial stress. A plot of the effective stiffness of the

wire as a function of the wires initial crookedness is given. Secondly, consideration is given to the possibility of buckling, within the matrix, of a compressively loaded straight wire. A plot of the buckling load of the wire as a function of the ratio of the wires and matrix's shear moduli is given. Two procedures are developed for the prediction of the lateral support offered to the wire by the matrix. Both procedures are developed by treating the matrix as a three-dimensional elastic solid, however, only the first of the two methods completely satisfies the displacement continuity requirements between the wire and the matrix. Author (TAB)

N67-29098# State Univ. of New York at Buffalo. School of Engineering.

FORCED MOTION OF SHALLOW SPHERICAL SHELLS

Herbert Reismann and Paul M. Culkowski Apr. 1967 82 p refs

(Grant DA-ARO(D)-31-124-G688)

(Rept.-21; AROD-5637-1-E; AD-650221) CFSTI: HC $3.00/MF $0.65

A formal solution is presented for the dynamic response of a shallow spherical shell under axisymmetric but otherwise arbitrarily distributed, time dependent surface tractions, for arbitrary initial conditions and (admissible) homogeneous boundary conditions. The solution is obtained in terms of the eigenfunctions associated with the free vibration of the shell, and appropriate orthogonality and normalization conditions are formulated. The free vibration problem for a clamped shell is solved, and an example of shell response to a transient loading condition is presented. The theoretical development and its application are carried out within the framework of a theory which accounts for the effects of shear deformation and rotatory inertia. A comparison with the theory which neglects these effects is presented. Significant differences in the predictions of the two theories are noted. Author (TAB)

N67-29123# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.

FATIGUE CRACK PROPAGATION UNDER PROGRAMMED AND RANDOM LOADS

J. Corey Mc Millan and Regis M. N. Polloux Jul. 1966 85 p refs

(D1-82-0553; AD-650417) CFSTI: HC $3.00/MF $0.65

The influence of maximum stress, stress range, and sequence of load application on the rate and mechanism of fatigue crack propagation in 2024-T3 aluminum alloy was studied by means of electron fractography. The macroscopic growth rates were determined on center-notched crack growth panels and the fracture surfaces were examined by electron fractography. An empirical equation relating relative microscopic growth rates at a given crack length to maximum loads and load amplitudes was obtained. It was also found that the advance of a fatigue crack front takes place only during the loading part of a cycle and that in the pseudorandom load case the sequence of load application can markedly influence crack growth rate on any one cycle. Author (TAB)

N67-29133# State Univ. of New York at Buffalo. School of Engineering.

ON THE PLANE STRAIN DYNAMIC RESPONSE OF A CYLINDRICAL SHELL UNDER LATERAL LOADS

Herbert Reismann and Peter S. Pawlik Apr. 1967 57 p refs

(Grant DA-ARO(D)-31-124-G-688)

(Rept.-22; AD-650624) CFSTI: HC $3.00/MF $0.65

An analytical investigation of the response of a circular cylindrical shell in plane strain acted upon by arbitrary, nonaxisymmetric, time dependent normal surface tractions was carried out. Solutions were generated for three levels of shell theory: (a) membrane theory, (B) Flugge theory (combined bending and membrane effects), (c) improved theory (including the effects of shear deformation and rotatory inertia). The solutions are expressed in terms of the characteristic response predicted by each theory. Finite series approximations are used to determine the characteristic response to any desired degree of accuracy. A numerical study of the initial response of the shell to a radially directed, concentrated, pure impulse was performed and detailed comparisons between the three shell theories are presented. Author (TAB)

N67-29148*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

APPLIED MECHANICS

In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 77–80 refs (See N67-29141 16-34)

Results of relative, full scale, total radiative heat load tests and of local radiation distribution measurements are summarized for three typical Mars entry-body shapes, and are briefly compared on the basis of total equilibrium shock-layer radiation. An analytical model is described for a nonhexagonal dovetail phenolic honeycomb spherical impact limiter, possessing good spherical curvature capability and energy-dissipating characteristics. N.E.N.

N67-29196# Rolls-Royce, Ltd., Derby (England).

CYCLIC TESTING FOR LIFE PREDICTION

D. McLean *In* AGARD Gas Turbines 1966 p 309–325 (See N67-29181 16-28)

Since the Aero Gas Turbine is not designed with large safety factors included to cover unknowns, it is necessary to operate to the maximum permissible stress levels acceptable for the life expected from the engine. With the very complex structures and components subjected to complex stress systems, although refined analytical stress analysis methods are used, they are still not sufficiently accurate to ensure that the components have absolute minimum weight for the desired function and life. This deficiency can be made good by submitting components, made to the first design, to a programme of cyclic testing on rigs in which they are subjected as far as is practicable to the environment and stresses they will experience on the engine. As minor failures occur throughout the test programme they are corrected by design changes until the optimum for the component is obtained. If the result is a component of excessively long life, the component can be redesigned to a reduced weight utilising the knowledge gained by the testing or, alternatively, advantage of the component can be taken by uprating the engine. Author

N67-29203*# Drexel Inst. of Tech., Philadelphia, Pa.

A UNIFIED APPROACH TO ONE-DIMENSIONAL ELASTIC WAVES BY THE METHOD OF CHARACTERISTICS

Pie Chi Chou and Richard W. Mortimer [1966] 43 p refs

(Grant NsG-270)

(NASA-CR-78493; Rept.-160-8) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A large number of elastic wave problems which involve one space variable are treated, in a unified manner, by a system of second-order hyperbolic partial differential equations, with the generalized displacements as dependent variables. This system of n equations is analyzed by the method of characteristics, yielding closed form equations for the physical characteristics, the characteristic equations, and the propagation of discontinuities. Procedures for numerical integration along the characteristic curves are established. Among the elastic wave problems that may be represented by this unified approach are the Timoshenko beam, plates, bars, and sheets, all including the lateral inertia and shear effects. Various approximate shell equations may also be represented. Results of numerical calculations are in agreement with those obtained by other methods. Author

N67-29281# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

FINEL, A PROGRAM TO SOLVE ELASTIC STRUCTURES BY THE USE OF FINITE ELEMENTS

W. B. Jordan 1 Dec. 1966 87 p refs

(Contract W-31-109-ENG-52)

(KAPL-M-6582) CFSTI: HC $3.00/MF $0.65

FINEL is a collection of three programs on the CDC-6600 for the calculation of the elastic and plastic behavior of structures

based on the finite element approach. The structures are built up from plates and bars, which can be arranged in either 2-dimensional or 3-dimensional assemblies. The plates can be in plane stress or plane strain. FINEL-2 handles 2-D structures only. FINEL-3 can handle both 2- and 3-D, but is slower. FINPUT is an aid for the preparation of input to the FINELs. Author (NSA)

N67-29421# Hughes Tool Co., Culver City, Calif. Aircraft Div.
PRELIMINARY DESIGN OF A ROTOR SYSTEM FOR A HOT CYCLE HEAVY-LIFT HELICOPTER Final Report, 17 Mar. 1965–31 Aug. 1966
John R. Simpson Mar. 1967 389 p refs
(Contract DA-44-177-AMC-225(T))
(HTC-AD-66-17; USAAVLABS-TR-67-1; AD-651217) CFSTI: HC $3.00/MF $0.65

In a preliminary design study of a rotor system for a Hot Cycle heavy-lift helicopter, the following items were accomplished. (1) an analytical procedure was developed that permitted calculation of fully coupled blade response and dynamic stability characteristics; (2) parametric and configuration studies involving basic characteristics of the rotor system were conducted; (3) design layouts, structural design studies, and detailed weight analyses were made (design and analysis were limited to the integrated lift-propulsion system with emphasis on the rotor system); (4) preliminary design was completed, and performance of the optimum rotor for the heavy-lift mission requirements was determined; (5) a fully coupled blade loads analysis of the optimum rotor was made; and (6) a full-scale mockup of the rotor hub area was constructed. Author (TAB)

N67-29466# Pennsylvania Univ., Philadelphia. Lab. for Research on the Structure of Matter.
MECHANICAL PROPERTIES
In its Lab. for Res. on the Struct. of Matter 30 Jun. 1966 p 53–62 refs (See N67-29462 16-06)

All mechanisms and properties relating to the material's response to mechanical stress are discussed. These cover hydrogen embrittlement; also relaxation and flow phenomena in polymer solutions, molten polymers, and amorphous and crystalline polymer solids. The majority of the projects, however, relate to the fundamental mechanisms controlling the deformation and fracture of metals and alloys. Author

N67-29470# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Mulheim an der Ruhr (West Germany). Institute fuer Festigkeit.
APPLICATION OF MICROFRACTOGRAPHY TO THE STUDY OF CRACK PROPAGATION UNDER FATIGUE STRESSES
Gerhard Jacoby Paris, AGARD, 1966 201 p refs Sponsored by AGARD
(AGARD-541) CFSTI: HC $3.00/MF $0.65

Starting from a variety of observations and hypotheses concerning crack propagation, the possibilities of applying macro- and principally micro-fractography to that stage of the fatigue process has been described. Microfractography—the examination of a fracture surface under high and ultrahigh magnification by means of an optical or an electron-microscope—makes it possible to study the mechanism of crack propagation under fatigue stresses in relation to external and internal parameters which are otherwise difficult or impossible to observe. Microfractography appears to be particularly suitable for the study of cumulative damage and for the determination of the cause of service failures. Author

N67-29490# Naval Research Lab., Washington, D. C. High Temperature Alloys Branch.
HIGH-TEMPERATURE VACUUM FATIGUE TESTING OF TYPE 316 STAINLESS STEEL AND INCONEL X WITH A RESONANCE-TYPE MACHINE
H. H. Smith, P. Shahinian, and M. R. Achter 27 Mar. 1967 17 p refs
(NRL-6489; AD-650934) CFSTI: HC $3.00/MF $0.65

A new resonance-type flexural fatigue machine has been used to test Inconex X, a low damping capacity material, and Type-316 stainless steel, a high damping material, at 500 degrees and 800 degrees C. A comparison was made of the reproducibility of the data obtained by various test procedures with smooth and notched specimens. Observations were made of the type of cracking in these materials. The progression of cracking appeared to be reflected in resonant frequency changes during the test. The reproducibility of the fatigue data, in particular of the Inconel X, which has a sharp resonance, is sufficiently good to permit distinguishing environmental effects, the main purpose for which the equipment was designed. Author (TAB)

N67-29506# IIT Research Inst., Chicago, Ill.
FRACTURE OF BRITTLE MATERIALS UNDER TRANSIENT MECHANICAL AND THERMAL LOADING
Ralph L. Barnett, Paul C. Hermann, James R. Wingfield, and Chester L. Connors Mar. 1967 153 p refs
(Contract AF 33(615)-2468)
(AFFDL-TR-66-220; AD-649978) CFSTI: HC $3.00/MF $0.65

The integrity of brittle elements subjected to time-dependent thermal and mechanical loads was predicted by means of an algorithm involving three steps: the determination of the temperature distribution, the determination of the thermal and mechanical stresses, and the statistical description of the resistance of the brittle material. Experiments were conducted on beams and disks under transient thermal and mechanical loads. The fracture probability-time curves obtained for these members are very accurately predicted by the fracture algorithm. The sensitivity of the beam and disk response to changes in the elastic, thermal, and statistical strength parameters was investigated. A combined stress fracture theory for brittle elements was developed which accounts for a history of thermal and mechanical loading. Author (TAB)

N67-29511# IIT Research Inst., Chicago, Ill. Mechanics Research Div.
A SURVEY OF THE METHOD OF INITIAL PARAMETERS
Walter D. Pilkey Mar. 1967 11 p refs
(Contract N00014-66-C0343)
(IITRI-M6157-1; AD-650912) CFSTI: HC $3.00/MF $0.65

The method of initial parameters provides a universal, physically appealing solution for the static and dynamic response of such classical structural members as strings, bars, beams, frames, arches, membranes, plates, thick and thin shells. The state-of-the-art is reviewed for this technique which is known in either an analytical or numerical form to the mathematician as the set of fundamental solutions or the initial value approach to boundary value problems; to the electrical engineer as the state variable approach of transition matrices; to the structural engineer by the names: Cauchy, transfer matrix, Krilov, line solution, Clebsch, progression matrix, Macauley, transmission matrix, Holzer-Myklestad, eigenmatrix, Foppl, carryover matrix, Laplace transform, singularity function, Wilson, reduction, Hetenyi, initial function, Puzyrevskii-Krylov, and universal equation method. The distinguishing feature of the method is the treatment of a problem in terms of physical quantities (initial parameters or state variables) that are of direct concern to analysts and designers. In the execution of a solution these state variables are transferred along the member from one end to the other. TAB

N67-29540# Advisory Group for Aerospace Research and Development, Paris (France).
A STATE-OF-THE-ART SURVEY OF METHODS BEING USED FOR THE EVALUATION OF COATINGS FOR SUPER ALLOYS AND REFRACTORY METALS
W. A. James May 1965 30 p refs
(AGARD-509) CFSTI: HC $3.00/MF $0.65

The survey indicated that methods for the determination of physical and mechanical properties were relatively well defined, after provision was made for testing at high temperatures. By

contrast, widely different methods were being used to determine resistance to corrosion, to erosion, to thermal shock and to thermal fatigue; the various methods are described in some detail. Usually one or more of oxidation resistance, resistance to erosion by hot gases and the effect of stress were evaluated simultaneously with resistance to thermal fatigue. The differences in evaluation procedures appeared to reflect differences in opinion concerning what was wanted from a test. Author

N67-29648# Lockheed Missiles and Space Co., Palo Alto, Calif. Solid Mechanics Group.
DEVELOPMENT OF IMPROVED STRUCTURAL DYNAMIC ANALYSIS. VOLUME II: COMPUTER GRAPHICS Final Report, Jul.–Nov. 1966
K. J. Forsberg and S. K. Ferriera Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Mar. 1967 92 p refs
(Contract AF 33(615)-3131)
(AFFDL-TR-66-187, Vol. II; L-30-66-2; AD-650932) CFSTI: HC $3.00/MF $0.65

The work is concerned with the application of a new tool (computer graphics) rather than the development of a new analytical technique. The problem of the dynamic response of a nonuniform beam was treated using the currently standard techniques of lumped mass-spring representation of the structure. A graphic input and output capability was attached to standard digital computer programs so that one can display on the face of a cathode ray tube the input parameters, modify these if desired, and then compute the modal behavior of the beam. The engineer can return to the initial input data, make changes, and rerun the program if he so desires. For the forced response problem, he can input his forcing functions, compute the forced response, and present the results in an animated display. This technique for communicating with the computer gives immediate reduction and interpretation of the results from the forced response program, a task which in the digital form requires many hours or even days. Author (TAB)

N67-29604# Army Materials Research Agency, Watertown, Mass.
STRESS CONCENTRATION FACTORS IN T-HEADS
Francis I. Baratta Nov. 1966 24 p refs
(AMRA-TR-66-36; AD-649808) CFSTI: HC $3.00/MF $0.65

Two simple formulae are presented which predict stress concentration factors applicable to a two-dimensional symmetrical T-head configuration. This configuration consists of a deep head joined to a shank by fillet radii. The independent equations that predict stress concentration factors for the same geometry are derived for two different loading conditions. In one instance, a tensile force is applied to the shank end of the T-shape. Equilibrium of forces is attained by supporting the bottom edge of the head section, resulting in the shank section being pulled in tension. In the second instance, a compressive load is applied to the top edge of the head section while the configuration is again supported at the bottom edge. Thus, only the head section is stressed and in a compressive manner. Because the analysis is not exact, the magnitudes of the stress concentration factors resulting from the predictive equations appear to be overly conservative at some ranges of the geometry parameter ratios. Therefore, an arbitrary limit of application, as it is termed in the text, is recommended when using these equations. Again, because of the inexactness of the analysis, experimental stress concentration factors are indirectly obtained for the first loading condition and directly obtained for the second loading condition mentioned above. These data were obtained for several geometric ratios of the T-head configuration and compared to the corresponding predicted values. TAB

N67-29649# IIT Research Inst., Chicago, Ill. Dept. of Mechanics
MINIMUM WEIGHT DESIGN OF STRUCTURES Final Report, 1 Feb. 1964–31 Jan. 1967
G. J. Megarefs 31 Jan. 1967 13 p refs
(Contract DA-31-124-ARO(D)-185)
(AROD-4551-7-E; AD-651139) CFSTI: HC $3.00/MF $0.65

When the proposal for the contract reviewed herein was submitted, it was expected that most of the time and effort would be spent in developing practical and approximate methods for determining the minimum volume design of complicated frames and other structures. It was however indicated in the proposal that priority would be given to some questions in the minimum volume design of axisymmetric plates, because of their fundamental importance. In answering these questions, it soon transpired that the possibility was created for obtaining exact solutions for a wide range of problems of axisymmetric plates and shells, which had not been previously attacked or which could now be treated in greater generality. As a result most of the time and effort during the period covered by the present report was devoted to obtaining exact solutions of the minimum volume design of axisymmetric plates. Author (TAB)

N67-29663# Oceanics, Inc., Plainview, N. Y.
AN EXPERIMENTAL INVESTIGATION OF PROPELLER BLADE THICKNESS AND APPENDAGE ASYMMETRY ON PROPELLER-APPENDAGE INTERACTION
August F. Lehman Jul. 1966 90 p refs
(Contract Nonr-3905(00) (X))
(Rept.-66-24; AD-651097) CFSTI: HC $3.00/MF $0.65

Experimental studies were undertaken in a water tunnel with three dimensional appendages involving the effect of propeller blade thickness and appendage asymmetry in the induced transverse and axial appendage forces. The propellers were mounted downstream of the appendage and the distance between the appendage and propeller varied. The propellers were tested both as three bladed units and as single bladed units. Both appendage asymmetry and propeller blade thickness have notable effects on the induced appendage forces. It appears as if the use of a single bladed propeller offers a promising technique for predicting multi-bladed performance in terms of induced appendage forces. Author (TAB)

N67-29759# Cornell Univ., Ithaca, N. Y.
WATER COOLED TARGETS FOR INTENSE ION BEAMS
P. R. Hanley, A. W. Haberl, and A. Taylor 27 Feb. 1967 18 p refs Presented at the Natl. Particle Accelerator Conf., Washington
(Contract AT(30-1)-3822)
(Rept.-646; NYO-3822-1; CONF-670307-26) CFSTI: HC $3.00/MF $0.65

Target backings cooled by water in linear flow have proven capable of dissipating heat loads from 2 kW ion beams focused to about 20 mm^2 for extended periods without structural failure. In addition to the more obvious modes of failure by plastic deformation and melting, metallographic studies of damaged targets have revealed deep void penetrations along grain boundaries. The targetry limitations imposed on maximum usable beam power by heat transfer from the backing to the cooling fluid were investigated. Neutron producing lifetimes of .LiF targets were compared for different proton beam and coolant flow conditions. Author (NSA)

N67-29770# New York Univ., N. Y. AEC Computing and Applied Mathematics Center.
EIGENFUNCTION EXPANSIONS ASSOCIATED WITH THE LAPLACIAN FOR CERTAIN DOMAINS WITH INFINITE BOUNDARIES
Charles Irwin Goldstein Feb. 1967 77 p refs
(Contract AT(30-1)-1480)
(NYO-1480-70) CFSTI: HC $3.00/MF $0.65

An expansion theorem for the negative Laplacian $-\Delta$ acting on functions with zero boundary conditions in a perturbed semi-infinite cylinder in N-dimensional Euclidean space ($N \geq 2$) is

proven. The case of an unperturbed cylinder is discussed. The spectral multiplicity is completely determined and a complete, orthogonal set of general eigenfunction is explicitly given. The finite end of the cylinder is then subjected to certain perturbations. Two sets of generalized eigenfunctions are constructed for the perturbed cylinder. They are constructed using the method of limiting absorption. The behavior of these eigenfunctions at infinity is described by means of a radiation condition analogous to the Sommerfeld radiation condition for the exterior problem. These functions are shown to form a complete, orthogonal set of generalized eigenfunctions for certain types of perturbed cylinders. Finally, it is shown for a wider class of domains that there can be at most a finite number of linearly independent generalized eigenfunctions associated with each real number. Author (NSA)

N67-29791# Sandia Corp., Albuquerque, N. Mex.
SHOCK ABSORBING SYSTEM FOR INSTRUMENT STATIONS LOCATED IN STRONG EARTH MOTION FIELDS
H. Holmes Feb. 1967 15 p
(Contract AT(29-1)-789)
(SC-TM-67-48) CFSTI: HC $3.00/MF $0.65

Instrument stations containing shock sensitive electronic equipment must frequently be placed at locations where earth motion from an underground blast is greater than motion the usual shock absorbing system will satisfactorily protect against. A shock absorbing system, utilizing crushable honeycomb that may be used alone or in conjunction with other shock aborbing systems, is described. Author (NSA)

N67-29816# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
DETACHED SHOCK CALCULATION BY SECOND ORDER FINITE DIFFERENCES
Arnold Lapidus Feb. 1967 55 p refs
(Contract AT(30-1)-1480)
(NYO-1480-69) CFSTI: HC $3.00/MF $0.65

A detached shock problem for a symmetric curved convex cylindrical body moving parallel to its plane of symmetry was solved using a third order accurate Richtmyer form of the Lax–Wendroff conservation equations. One innovation is an easy to use "artificial viscosity" term which preserves the high order of accuracy of the calculation while removing the nonlinear instabilities which otherwise appear in the shock region and near boundaries. Another innovation is a simple transformation of Cartesian space which changes the curved body into a straight line, thus reducing the large number of special points and irregularly shaped mesh regions which would otherwise appear in the difference method calculation. Such transformations are shown to preserve the conservation property of the system of differential equations. Other aspects of the third order artificial viscosity term and the transformation are discussed. The results of a numerical calculation on a CDC 6600 Computer are compared to known results. Author (NSA)

N67-29857# Sandia Corp., Albuquerque, N. Mex.
EARTH PENETRATION POST-TEST SOIL EXPLORATION TECHNIQUE
John L. Colp Feb. 1967 52 p refs
(Contract AT(29-1)-789)
(SC-RR-66-2617) CFSTI: HC $3.00/MF $0.65

The need for conducting earth penetration tests to obtain information that will aid in a more complete understanding of the earth penetration mechanism is discussed. Methods for investigating the effects of a penetration test upon the surface of the earth target are described. Subsurface soil exploration methods are discussed, and ways to secure, protect, and handle the required soil samples are given. Observations and tests that must be made in the subsurface are described. Author (NSA)

N67-29912*# Republic Aviation Div., Fairchild Hiller Corp., Farmingdale, N. Y.
EXPERIMENTAL DETERMINATION OF SYSTEM PARAMETERS FOR THIN-WALLED CYLINDERS Annual Summary Report, 1 Jul. 1965–31 Aug. 1966
Robert S. Levy and Marvin J. Forray 31 Aug. 1966 101 p refs
(Contract NAS8-11514)
(NASA-CR-79758; FHR-1117-20) CFSTI: HC $3.00/MF $0.65
CSCL 20K

Tests and analyses were conducted on the problem of predicting the natural frequencies and mode shapes of weighted, pressurized cylinders without stringers. A digital computer program capable of computing the resonant frequencies of pressurized cylinders with frames and an attached mass was developed. Used in the experiments was a specimen consisting of an 0.020 gage aluminum cylinder, 36 inches in diameter, 36 inches long, with heavy frames spaced at 6 inches. Mechanical impedance measurements were made with an impedance head that had a weight downstream of the force gage of only 0.35 gram. The mass cancellation circuitry was further investigated. The sensor modal that was used to measure cylinder motion during acoustic noise excitation permitted measurement of the dynamic response of a truly unweighted cylinder. Shell modes higher than the fundamental were identified and measured on a weighted cylinder. Cylinder excitation using the vibration shaker, acoustic horn, and the mallet thump gave consistent values of the fundamental resonant frequency. K.W.

N67-29928# National Aerospace Lab., Tokyo (Japan).
ENERGY INEQUALITIES FOR THE DIFFERENCE SOLUTIONS OF EQUATION OF ELASTIC VIBRATION
Hajime Miyoshi 1966 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-117) CFSTI: HC $3.00/MF $0.65

Two typical difference equations for solving the equation of elastic vibration under arbitrary physical boundary conditions are considered. Energy inequalities for their solution are deduced. From these, stability of the difference solutions and the convergence to solutions of their original problem are proved. Author

N67-29957# TRW Systems, Redondo Beach, Calif.
RADIOISOTOPE PROPULSION TECHNOLOGY PROGRAM (POODLE). VOLUME IIB: ANALYTICAL PROGRAM FOR CREEP IN AXISYMMETRIC BODIES (CRAB) Final Report, Oct. 1, 1965–Sep. 30, 1966
G. A. Greenbaum Oct. 1966 57 p refs
(Contract AT(04-3)-517)
(STL-517-0049, Vol. IIB) CFSTI: HC $3.00/MF $0.65

An analysis and a numerical computer program were developed for the calculation of creep strains in an arbitrary axisymmetric body of revolution subject to axisymmetric loads. The method of solution is an extension of the direct stiffness method. The body is replaced by a system of discrete triangular cross section ring elements interconnected along circumferential nodal circles. The equations of equilibrium for the body are derived from the principle of minimum potential energy. The creep behavior of the body is obtained by the use of an incremental approach. The method involves starting with the elastic solution of the problem and calculating the creep strains for a small time increment. These creep strains are treated as initial strains to determine the new stress distribution at the end of the time increment. The procedure is repeated until either the final time or, a steady-state condition is reached. The method is quite general and is independent of the type of creep law used. Results are presented for a plane-strain cylinder solution and a pressure vessel with spherical end caps. Author (NSA)

N67-29968*# Aerojet-General Corp., Sacramento, Calif.
NES/ETS-1 DUCT STRUCTURAL DYNAMICS. NERVA PROGRAM
Aug. 1965 108 p refs
(Contract SNP-1)
(NASA-CR-85232; TID-23648; RN-S-0211) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The final structural dynamics analysis of the Nuclear Exhaust System (NES) duct for the Engine Test Stand No. 1 (ETS-1) at NRDS is presented. The duct assembly is designated SST-2, subsonic turn configuration. Using digital computer techniques, structural vibration modes and natural frequencies of the exhaust duct assembly were obtained. Dynamic stresses along the duct section under full scale nuclear (NERVA) engine operation were calculated. As a result of this analysis the structural dynamic integrity as well as the overall structural design stability has been proven to be adequate for the NES for ETS-1. Author (NSA)

N67-30000*# Goodyear Aerospace Corp., Akron, Ohio.
FEASIBILITY INVESTIGATION OF EXPANDABLE STRUCTURES MODULE FOR ORBITAL EXPERIMENT—ARTIFICIAL G
Robert J. French Jun. 1967 62 p refs
(Contract NAS1-6673)
(NASA-CR-66351; GER-13146) CSCL 22B

An expandable structures design concept using a flexible materials composite was investigated and a 30-foot long by 12-1/2-foot diameter prototype fabricated. The work was directed toward a proposed erectable cylinder which would be launched in the packaged condition and subsequently rendezvoused with a manned Apollo command service module. The primary prototype structural material used is a special Dacron tape, 2 inches wide which is longitudinally and circumferentially applied by hand. The cage-type structure confines a bladder comprised of a nylon fabric–film–fabric layer on the inside, a vinyl–foam layer, and an outside nylon–fabric layer. A 1-3/4-inch thick layer of flexible polyurethane foam is applied on the outside of the structure for micrometeoroid protection. Another film–fabric laminate is outside this layer which seals this space to permit squeezing down by evacuating for packaging purposes. Stainless steel tape in place of Dacron tape is considered. Author

N67-30051 Lockheed Missiles and Space Co., Sunnyvale, Calif.
APPLICATION OF THE V. Z. VLASOV VARIATIONAL METHOD TO THE ANALYSIS OF A CIRCULAR CYLINDRICAL SHELL UNDER LOCAL LOADING
B. V. Narubailo [1967] 6 p refs Transl. into ENGLISH from Izv. VUZ. Aviats. Tekh. (Kazan), no. 1, 1967 p 45–50

The effect of local loading on a cylindrical shell is determined on the basis of an eighth order differential equation. An attempt is made to obtain an approximate solution by using the variational method. Approximating functions are selected for the effect of a radial loading on a shell. To construct a particular solution for the radial force case, the magnitude of the jump in the transverse bimoment at the point of loading application is calculated. Finally an expression for the longitudinal stress resultant and the bending moment in a shell loaded by a radial force distribution uniformly over the area is presented. S.P.

N67-30052 Lockheed Missiles and Space Co., Sunnyvale, Calif.
DYNAMIC INSTABILITY DOMAINS OF PARAMETRICALLY EXCITED SYSTEMS WITH AN INFINITE NUMBER OF DEGREES OF FREEDOM
V. N. Fomin [1967] 30 p refs Transl. into ENGLISH from Probl. Matem. Fiz. (Leningrad), 1966 p 135–165

The concept of dynamic instability domain in a first approximation is introduced and formulas are derived for finding the boundaries of this set. Formulas are presented for the approximate solution of the considered system, which corresponds to a characteristic exponent with greatest real part. Dynamic stability equations of rectilinear prismatic rods subject to the effect of longitudinal periodic loading are investigated. Analogous problems for the dynamic stability equations of the plane bending mode are solved. The peculiarity of this system is that its instability is determined primarily by the interaction between the different degrees of freedom. The methods based on seeking conditions necessary for the existence of periodic solutions of the system may not be used directly to find the boundaries of the most unstable sets. Cases of the vibration of systems under the effect of the so-called following forces are considered. Such systems do not generally reduce to a Hamiltonian. First-approximation formulas are obtained to find the characteristic exponents of such a system and some peculiarities due to their nonconservativity are noted. S.P.

N67-30053 Lockheed Missiles and Space Co., Sunnyvale, Calif.
EXPERIMENTAL INVESTIGATION OF THE STABILITY OF A CYLINDRICAL SHELL UNDER LONGITUDINAL IMPACT
V. I. Borisenko and V. T. Voloshin [1967] 8 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 3, no. 4, 1967 p 45–52

Test data on the stability of a series of cylindrical shells under longitudinal impact are described. Photographs are made of the buckling process with the aid of a high-speed moving picture camera. The experimental results are compared with theory. It is shown that taking account of experimental results on the longitudinal stress resultants in the shell permits obtaining a theoretical value of the critical velocity which is close to the experimental value. Author

N67-30060 Lockheed Missiles and Space Co., Sunnyvale, Calif.
ON THE STABILITY OF A CIRCULAR CYLINDRICAL SHELL IN A SUPERSONIC GAS FLOW
E. D. Skurlatov [1967] 7 p refs Transl. into ENGLISH from Strength and Stability of Thin-walled Structures (Moscow), 1967 p 201–209

The panel flutter of a closed circular cylindrical shell of medium length is investigated taking account of axial compressive forces and structural damping. It is also shown in what manner the apparent mass of the fluid filling the shell affects the critical flutter velocity. In determining the apparent mass of the fluid the problem is reduced to solving the equation of fluid motion and accounting for the boundary conditions on the oscillating wall of the cylindrical shell. It is assumed that the fluid is ideal and incompressible and that its motion is isentropic and potential. S.P.

N67-30084# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
EVALUATION OF HOOP STRENGTH OF FILAMENT-WOUND CYLINDERS BY NEWLY-PROPOSED ISAS RING TEST AND BURST TEST
Kozo Kawata, Shinji Fukui, Akira Kobayashi, and Shozo Hashimoto Mar. 1967 9 p refs
(ISAS-409, Vol. 32, No. 2) CFSTI: HC $3.00/MF $0.65

The ISAS ring test is proposed to give a quick evaluation of hoop strength of filament-wound cylinders with arbitrary winding pattern. The width variation effects are also investigated. The obtained ISAS ring test values are roughly coincident with the usual hydraulic burst hoop strength, in general. The present evaluation of filament-wound cylinders through the ISAS ring test shows: (1) 50 to even 70 Kg/mm^2 hoop stress, (2) the winding pattern has a close relation with the strength, (3) the 2-to-1 orthogonal winding pattern gives the higher hoop strength than those obtained for the optimum 54.75° by about 22%, and (4) the strength is quite sensitive to the surface treatment of glass-filament. Author

N67-30091# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
BODY DIVERGENCE OF A MULTI-STAGE ROCKET
Ken Ikeda and Yoichi Hirano Mar. 1967 10 p refs
(ISAS-411, Vol. 32, No. 4) CFSTI: HC $3.00/MF $0.65

The divergence speed of a multistage rocket is derived by extending the analysis for a single-stage rocket. The loading factor and angle of attack are emphasized. The total lift is assumed to be separated into components on several points of the body and the inertia force of the body is equated with these separated lifts. A numerical example is included. N.E.N.

N67-30106# Swedish State Shipbuilding Experimental Tank, Goteborg.
FUTURE DESIGN OF SHIP LINES BY USE OF ANALOGUE AND DIGITAL COMPUTERS
Ake Williams 1966 28 p refs
(Rept.-59) CFSTI: HC $3.00/MF $0.65

Alternative methods for design of ship lines by use of computers are discussed. Special interest is devoted to the use of drafting equipment in combination with digital and analogue computers. As an introduction some general points of view are given regarding mathematical definition of ship lines and its application to shipbuilding in theory and practice. The construction of ship lines can be performed graphically and mathematically and will be based on single form coefficients as well as form defining parameters of hydrostatic and hydrodynamic meaning. For an analysis of the hull form in order to find connections with results from model tests, the single form coefficients are unreliable. The numerically controlled drafting equipment provides good accuracy for full scale use and permits drawing of all kinds of sections. Author

N67-30124*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AXISYMMETRIC VIBRATIONS OF PARTIALLY LIQUID-FILLED CYLINDRICAL CONTAINERS
Rudolf F. Glaser Washington, NASA, Jul. 1967 43 p refs
(NASA-TN-D-4026) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A vibration analysis is made of partially liquid filled flexible cylindrical shells with flat rigid bottoms. The analysis is restricted to axisymmetric vibrations and is based on membrane theory, since axial bending of the cylinder wall affects only slightly the fundamental frequencies of the system. A comparison of numerical and test results confirms this behavior. Motion equations and boundary conditions for the cylindrical shell are stated and a free vibration analysis is made of the liquid shell free surface system. Free vibration analyses based on the assumptions of zero ullage pressure and liquid compressibility are also made. Finally, a forced vibration analysis is made of the partially liquid filled cylindrical shell with a flat rigid bottom and the results compared with those of Bleich. R.N.A.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-28963# Brown Univ., Providence, R. I.
THE EFFECT OF VIBRATIONS AND OSCILLATIONS ON HEAT TRANSFER FROM A CIRCULAR CYLINDER
P. D. Richardson Wright-Patterson AFB, Ohio, ARL, Nov. 1966 105 p refs
(Contract AF 33(615)-1263)
(ARL-66-0235; AD-649714) CFSTI: HC $3.00/MF $0.65

An analysis is described for convection from a circular cylinder subjected to transverse oscillations relative to the fluid in which it is immersed. The analysis is based upon use of the (acoustic) streaming flow field. Solutions are presented which are appropriate for a wide range of Prandtl number, and the cases of small and of large streaming Reynolds number are distinguished. The analysis compares favorably with experiments when the influence of natural convection is small. An introduction is given to the accounting of convection by a combination of streaming and natural convection. Author (TAB)

N67-28967# ARO, Inc., Arnold Air Force Station, Tenn.
SOME ASPECTS OF THERMAL MODEL TESTING IN SPACE CHAMBERS Technical Report, May 1964–Nov. 1966
K. W. Nutt and J. A. van der Bliek Arnold Eng. Develop. Center, Apr. 1967 30 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-38; AD-650814) CFSTI: HC $3.00/MF $0.65

Various facets of thermal testing of space vehicles in cold vacuum chambers, with and without solar simulation, are discussed. Emphasis is on thermal modeling of spacecraft. Thermal modeling is discussed for the case of simultaneous preservation of temperature, material and surface properties. The following specific items are treated: a criterion for the application of isothermal modeling is developed and illustrated with experimental data, rules for nonisothermal modeling are discussed and illustrated with experimental results, the effect of internal convection is calculated and modeling rules are developed, the effect of internal radiation is discussed and the relative importance illustrated theoretically, and a criterion is developed for the degree of intensity nonuniformity for a solar simulator in terms of desired temperature accuracy. Author (TAB)

N67-29000# Naval Radiological Defense Lab., San Francisco, Calif.
OXYGEN CONCENTRATION AND PRESSURE EFFECTS ON THE IGNITION OF CELLULOSIC FUELS BY THERMAL RADIATION
Norman J. Alvares 17 Feb. 1967 28 p refs
(USNRDL-TR-67-25; AD-650622) CFSTI: HC $3.00/MF $0.65

Measurements of the ignition time and surface temperature, at the time of ignition for cellulosic fuels in varying atmospheric environments were made in order to help illuminate the mechanism responsible for the spontaneous ignition of these materials exposed to thermal radiation. It was assumed that the mechanism would fall into one of three categories, and these were: (1) A piloted self-ignition, which is dependent in some way upon the temperature of the pyrolyzing solid. (2) A thermal self-ignition which is governed mainly by gaseous heat transfer. (3) A free-radical chain branching self-ignition which should be quite pressure dependent. The varied environmental atmospheric parameters were: (1) Total atmospheric pressure, holding the oxygen concentration constant; (2) oxygen concentration with the total pressure held constant; and (3) the thermal conductivity of the atmospheric environment by use of different diluent gases with both the total pressure and oxygen concentration held constant. Both the surface temperature and ignition response data provide evidence which indicate the thermal self-ignition to be the most likely mechanism responsible for this phenomena. Author (TAB)

N67-29040*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FREQUENCY RESPONSE OF FORCED-FLOW SINGLE-TUBE BOILER
Eugene A. Krejsa, Jack H. Goodykoontz, and Grady H. Stevens Washington, NASA, Jun. 1967 37 p refs
(NASA-TN-D-4039) CFSTI: HC$3.00/MF$0.65 CSCL 13A

Experimental frequency-response techniques were used to obtain pressure and flow-perturbation data for a hollow single-tube boiler. The flow rate of the test fluid was sinusoidally varied about a mean value. Amplitudes and phase angles of the pressure and flow perturbations were measured at the boiler inlet. The boiler test section was a shell and tube heat exchanger. Freon-113 was the test fluid flowing inside the inner tube that had an inside diameter of 0.315 inch (8.0 mm) and a heated length of 36 inches (0.91 m). Hot water flowed countercurrent to the Freon flow in the annulus between the inner tube and the outer jacket. The data are presented in terms of the boiler-inlet impedance as a function of disturbance frequency. For all conditions investigated, the boiler-inlet impedance was found to be a function of exit vapor quality; the magnitude of the impedance was larger at the higher qualities. Author

N67-29102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GENERALIZATION OF THE CHARACTERISTICS OF ELECTRIC ARCS [OBOBSHCHENIYE KHARAKTERISTIK ELEKTRICHESKIKH DUG]
O. I. Yas'ko 23 Jan. 1967 12 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), no. 12, 1964 p 112–116
(FTD-HT-66-397; AD-650478) CFSTI: HC$3.00/MF$0.65

From energy relations, a set of criteria is obtained for electric arcs, and the results are applied to the volt-ampere characteristics of the system. It is shown that the complex phenomenon associated with electric arcs can be represented by generalized characteristics. TAB

N67-29132# Naval Ordnance Test Station, China Lake, Calif. Research Dept.
STATUS OF SOLID ROCKET COMBUSTION INSTABILITY RESEARCH
E. W. Price Feb. 1967 44 p refs
(NOTS-TP-4275; AD-650200) CFSTI: HC$3.00/MF$0.65

A review is presented of the status of research in the U. S. on the subject of solid rocket combustion instability, with particular emphasis on work in the period 1960-1966. Author (TAB)

N67-29198# Technische Hochschule Aachen (West Germany). Institut fuer Weermetechnik und Verbrennungsmotoren.
LIQUID COOLING OF GAS-TURBINE BLADES WITH FORCED CONVECTION
Hans May *In* AGARD Gas Turbines 1966 p 355–367 refs (See N67-29181 16-28)

The liquid cooling of gas-turbine blades at forced convection was investigated using an organic coolant. The experiments were carried out on a cascade at rest for various pressure ratios, coolant flows, coolant temperatures and various cooling-hole arrangements at gas temperatures up to 1200°C (for a short time 1300°C). The temperature decrease within the blade was found to be 500–600°C at a gas temperature of 1200°C and a coolant temperature of 200°C. The measured temperature-distribution agrees satisfactorily with analytical results. Only at the leading-edge stagnation point is there a greater difference between calculated and experimental temperature. For some examples, the influences of the heat, conducted by the coolant, on the efficiency and the specific power of a gas turbine are shown. Author

N67-29199# Technische Hochschule Aachen (West Germany).
INVESTIGATIONS OF THE TEMPERATURE DISTRIBUTION AND HEAT TRANSFER IN GAS TURBINE BLADES
Wilhelm H. Dettmering *In* AGARD Gas Turbines 1966 p 369–380 ref (See N67-29181 16-28)

Two experimental methods were used in investigations on gas turbine blades to determine temperature distribution and heat transfer. Measurements performed on a rotating turbine wheel in operation were supplemented by means of an electrical analogy. A description is given of the experimental gas turbine built for the purpose and of the electrical analogy test stand used. Some of the results obtained are presented, with illustrations, and discussed. Author

N67-29224# State Univ. of New York, Stony Brook. Coll. of Engineering.
INFRARED RADIATIVE HEAT TRANSFER IN NONGRAY GASES Interim Technical Report, 15 Aug. 1965–15 Sep. 1966
R. D. Cess, P. Mighdoll, and S. N. Tiwari Wright-Patterson AFB, Ohio, ARL, Jan. 1967 43 p refs
(Contract AF 33(615)-3104)
(ARL-67-0015; AD-651218) CFSTI: HC$3.00/MF$0.65

The object of the investigation was to study various approximate methods of analyzing infrared radiative heat transfer in nongray nonisothermal gases. For this purpose, a very simple physical system was chosen, and this consists of a gas bounded by two infinte parallel black plates having the same uniform temperature. There is a uniform heat source (or sink) within the gas. Furthermore, attention was restricted to gases having a single fundamental vibration-rotation band, such that the results are quantitatively applicable only to diatomic gases. The qualitative conclusions, however, apply to any gas which radiates in the infrared. It is found that for intermediate optical thicknesses, the line structure of the vibration-rotation band can have a significant effect upon the temperature distribution within the gas. Predictions based on the gray gas assumption are shown to be greatly in error. It is further illustrated that one cannot apply the optically thick limit to an entire vibration-rotation band, since there will always be an optically non-thick region in the band wings, and such regions will contribute significantly to the radiative transfer process. Author (TAB)

N67-29416# National Bureau of Standards, Washington, D. C.
PROCEDURES FOR PRECISE DETERMINATION OF THERMAL RADIATION PROPERTIES, NOVEMBER 1964–OCTOBER 1965
J. C. Richmond, G. J. Kneissl, D. L. Kelley, and F. J. Kelly 10 Feb. 1967 88 p refs Sponsored by AF
(NBS-TN-292; AD-649694) CFSTI: HC$3.00/MF$0.65

The broad overall objective of this continuing program is to develop equipment and procedures for measuring the important thermal radiation properties of materials, particularly those used in aircraft, missiles and space vehicles, at temperatures up to the melting point of the most refractory material, and to develop physical standards for checking such equipment and procedures. During the period covered by the report the specific objectives were (1) continued development of the laser-source integrating sphere reflectometer, (2) an error analysis of the shallow cavity technique for measuring normal spectral emittance standards for use at temperatures above 1400°K (about 2000°F). An error analysis of the shallow cavity technique for measuring total normal emittance of ceramic materials at very high temperatures showed that there was an error due to the translucency of the specimens that was as much as +60% for alumina, and a second error due to thermal gradients in the specimen that was on the order of −10%. Two new techniques were devised in the hope of greatly reducing the translucency error. Progress was made in developing codes to compute and correct for the thermal gradients present in the

specimen. The laser-source integrating sphere reflectometer for measuring reflectance of specimens at very high temperatures was extensively redesigned to eliminate errors due to flux reaching the detector on the first reflection, and to convert the reflectometer from the substitution to the comparison mode. A literature search was made of techniques for measuring thermal radiation properties of solids at temperatures above 2500°K (4000°F). Author (TAB)

N67-29461*# Michigan Univ., Ann Arbor. Aircraft Propulsion Lab.

TWO PHASE DETONATIONS AND DROP SHATTERING STUDIES Annual Progress Report, 1 Feb. 1965–31 Jan. 1966

E. K. Dabora, K. W. Ragland, and A. A. Ranger Apr. 1966 174 p refs

(Contract NASr-54(07))

(NASA-CR-85000; Rept.-06324-2-T; APR-2) CSCL 21B

The theoretical properties of C–J detonations in two phase mixtures of liquid diethylcyclohexane and gaseous oxygen are presented for an equivalence ratio range of .1–3. Experiments on detonations in monodisperse sprays with drop sizes of 290, 750, and 940μ are described. Experiments in which the fuel is in the form of a thin film on the walls of the tube are also described. Studies of drop shattering under conditions similar to those of detonations are initiated. A review of the theoretical and experimental studies found in the literature is presented, and the results on water drops of 750 and 1090μ in diameter subjected to M=1.5, 2.7, and 3.25 shocks are described. Preliminary results on the velocity of the drops and their deformation after the passage of the wave are included. A 1080μ drop is found to be completely shattered in 135 μsec when shock M=3.25. The Weber number in all the experiments is very much larger than the critical and hence shear type breakup is observed throughout. Author

N67-29550# Naval Ordnance Lab., White Oak, Md.

EQUILIBRIUM AIR RADIATION FROM THE STAGNATION REGION OF HIGH VELOCITY SPHERES

Robert A. Leverance and Eugene J. Ruane 21 Dec. 1966 20 p refs

(NOLTR-65-199; RR-151; AD-650924) CFSTI: HC $3.00/MF $0.65

Experimental air radiation intensity measurements were taken in the stagnation region of high velocity models. The models used were copper-clad nylon spheres. Initial range conditions varied in velocity from 16,000 to 19,000 feet per second, and in pressure from 8 to 24 torr. Radiation measurements were taken over narrow (20A) bands in the spectrum from 2750 to 5900 angstroms. The experimental values were in close agreement with theoretical predictions. Author (TAB)

N67-29568# Advisory Group for Aerospace Research and Development, Paris (France).

A NEW SPECIAL SOLUTION TO THE COMPLETE PROBLEM OF THE INTERNAL BALLISTICS OF GUNS

C. K. Thornhill (Royal Armament Res. and Develop. Estab., Fort Halstead) 1966 52 p refs

(AGARD-550) CFSTI: HC $3.00/MF $0.65

A new special solution is given to the complete problem of gun internal ballistics, of which Pidduck's special solution to Lagrange's ballistic problem is a simple special case. The solution is special in the sense that it is a similarity solution, in which the essential space variable is separated from the time variable, and so is derived by solving ordinary rather than partial differential equations. The restrictive assumptions on which the new solution is based are very few indeed. There are three scale factors and seven modelling parameters in the general solution obtained, and two numerical examples are given for widely differing families of internal ballistics, which illustrate the salient features of the solution. Author

N67-29588# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mathematics.

AN AXIOMATIC FOUNDATION FOR CONTINUUM THERMODYNAMICS

Morton E. Gurtin and William O. Williams Jan. 1967 70 p refs

(Contract Nonr-51031)

(Rept.-67-5; AD-649818) CFSTI: HC $3.00/MF $0.65

The report presents a complete set of axioms, based upon physically acceptable gross forms of the laws of thermodynamics, which yield appropriate forms of these laws for continuum physics; and find conditions under which these reduce to the classical forms. TAB

N67-29603# Army Materials Research Agency, Watertown, Mass.

THERMAL FLUX DISTRIBUTION IN AN ARC-IMAGING FURNACE

Raymond L. Farrow and Michael J. Matkovich Dec. 1966 22 p refs

(AMRA-TR-66-39; AD-649809) CFSTI: HC $3.00/MF $0.65

To effectively utilize an arc-imaging furnace as a source of controlled thermal energy, the flux density received at the sample must be known. A commercially available, double-elliptical, arc-imaging furnace has been calibrated using both an integrating calorimeter and a discriminating radiometer. The results show the thermal flux received over both a 0.9-mm-diameter area and a 9.5-mm-diameter area as a function of three-dimensional position within the receiving zone. In addition, flux contour maps are presented for several appropriate planes in the focal zone. The effects of rotating interrupter shutters on both heat flux and optical temperature measurements are discussed. TAB

N67-29632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Aero Propulsion Lab.

A SHOCK TUBE STUDY OF THE IGNITION DELAY OF HYDROGEN-AIR MIXTURES NEAR THE SECOND EXPLOSION LIMIT

Roger R. Craig Nov. 1966 35 p refs

(AFAPL-TR-66-74; AD-649771) CFSTI: HC $3.00/MF $0.65

An investigation of the ignition delay of hydrogen-air mixtures near the second explosion limit at pressures of 15 and 30 psia was made in a shock tube. The shock tube calculations are discussed along with the problems encountered during the investigation. Attempts to correlate the data were satisfactorily accomplished when the HO2 recombination rate was assumed to be proportional to T-0.4. TAB

N67-29658# Aerospace Research Labs., Wright-Patterson AFB, Ohio.

DROPLET VAPORIZATION WITH LIMITING HEAT TRANSFER FROM THE CARRIER GAS Final Report, Sep. 1964–May 1966

Alfred C. Pinchak Nov. 1966 24 p refs

(ARL-66-0237; AD-649597) CFSTI: HC $3.00/MF $0.65

A special case of droplet vaporization is considered in which the evaporation process is limited by the rate of heat transfer from the carrier gas to the droplet. As the droplet vaporizes, it partially or completely saturates the environment; this saturation effect then reduces the instantaneous vaporization rate. With the restriction of small total droplet mass per unit mass of carrier gas, a first order, non-linear, ordinary differential equation is found to describe the vaporization process. One constant parameter C appears in the vaporization equation. Special values of C are considered which permit integration in closed form. A numerical example of some typical vaporization times is also included. Author (TAB)

N67-29875# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
EXPERIMENTAL INVESTIGATION OF HIGH-FREQUENCY LONGITUDINAL COMBUSTION INSTABILITY IN GASEOUS PROPELLANT ROCKET MOTORS
Craig Thomas Bowman (Ph.D. Thesis) Jan. 1967 178 p refs
(Contract AF 49(638)-1268)
(TR-784; AFOSR-66-2725; AD-649860) CFSTI: HC $3.00/MF $0.65

The properties of the longtitudinal mode of high-frequency combustion instability in a rocket motor burning premixed gaseous propellants were determined experimentally. The experimental observations were compared with the results of a non-linear instability theory based on a chemical kinetic driving mechanism. It was shown that the theory gives the correct waveform for longitudinal instability. In addition the theory gives the correct qualitative dependence of the stability limits on the mean combustion temperature and activation energy. Harmonic mode longitudinal instabilities were observed. The dependence of the stability limits and instability strength on the mean combustion pressure, combustion chamber length, injector and exhaust nozzle was determined experimentally. Based on the general agreement between the experimental observations and theoretical results it is concluded that the appropriate driving mechanism for high-frequency longitudinal gas-phase combustion instability is chemical kinetics.
Author (TAB)

N67-29787# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
RAT-3D: A GENERAL THREE-DIMENSIONAL HEAT TRANSFER CODE
Suzanne S. Clark and M. Troost 10 Oct. 1966 227 p ref
(Contract AT(04-3)-167)
(GAMD-7348) CFSTI: HC $3.00/MF $0.65

The RAT-3D program is a FORTRAN IV code for solving transient, three-dimensional heat transfer problems. The nonlinear-partial-differential heat transport equation has been rewritten as a set of quasilinear finite difference equations. This set of equations is solved by a mathematically stable alternating gradient method. Some special features are: anisotropic thermal conductivities, radiation across internal gaps, internal and external coolants, description of material properties as functions, and simple geometrical input. A small subroutine, LINK, is written in MAP. This subroutine is difficult to convert because it is compiler dependent.
Author (NSA)

N67-29850# Institut Franco-Allemand de Recherches, St. Louis (France).
SHOCK INDUCED COMBUSTION IN THE BOW WAVES OF HIGH SPEED MISSILES
H. Behrens, W. Struth, and F. Wecken [1966] 27 p refs
(ISL-2/66)

High velocity firings of spheres or cone cylinder missiles into mixtures of hydrogen with air or oxygen were studied with regard to the amount of heat addition by chemical reaction. With spherical missiles this was done by determining the temperature of the combustion gas behind the sphere by a method based on the refraction of the wake shock at the boundary of the combustion gas and of the cold non-reacted ambient gas. The results, as function of the Mach number M of the missile velocity, were expressed in terms of relative heat addition and compared to results with cone cylinder missiles. In these experiments the heat addition is derived from the shock wave angle.
Author

N67-29874# Atomic Energy Establishment, Winfrith (England).
MODEL FOR CORRELATING BURNOUT IN ROUND TUBES
G. J. Kirby Sep. 1966 36 p
(AEEW-R-511) CFSTI: HC $3.00/MF $0.65

A model is presented which represents the film flow rate in the climbing film regime of boiling two-phase flow. By calculating the dryout point, burnout heat fluxes for round tubes both uniformly and non-uniformly heated axially have been predicted with accuracies as good as the best empirical correlations. The model is used to investigate the effect of varying flux profile.
NSA

N67-29875# Atomic Energy Establishment, Winfrith (England).
AN INVESTIGATION OF HEAT EXCHANGER FOULING IN DUST SUSPENSION COOLING SYSTEMS USING GRAPHITE POWDER AND CARBON DIOXIDE GAS
D. A. Garton, R. I. Hawes, and P. W. Rose 1966 26 p
(AEEW-R-509) CFSTI: HC $3.00/MF $0.65

Experiments were performed to study the fouling of heat exchanger surfaces where heat is being transferred from a heated fluid to a cooled surface. The fluid studied was a suspension of 4 to 5 microns mean diameter graphite powder in carbon dioxide gas at near atmospheric pressures. The solids loading range covered was from 5 to 30 lb graphite/lb carbon dioxide, and gas Reynolds numbers were from 6000 to 16000. Temperature gradients of from 20 to 120°C across the cooler were obtained. The heat transfer ratio is correlated to show the dependence upon the solids loading ratio of the suspension, the gas Reynolds number and the temperature gradient across the cooler. The results demonstrated that stringent precautions are necessary to ensure complete dryness of the graphite powder and the loop flow surfaces before any useful quantitative fouling data can be obtained, as the presence of entrained moisture will accelerate the deposition of material on the cold walls of the heat exchanger and can result in plugging. The heat transfer coefficient showed no obvious dependency upon either the gas Reynolds number or the temperature gradient across the cooler over the range investigated. The measured heat transfer coefficient was considerably lower than that obtained when the heat is transferred from a hot wall to a cooler fluid. At a solids loading of 30 lb graphite/lb carbon dioxide, the heat transfer coefficient was only 50% of that for heat transfer from a heated wall. At solids loadings below 7 lb/lb, the heat transfer was less than that for a gas alone.
NSA

N67-29938# European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center.
COMPUTATION OF THE COMPRESSION OF A MAGNETIC FIELD BY MEANS OF A LINER DRIVEN BY AN EXPLOSION
L. Guerri, P. Stella, and A. Taroni Apr. 1967 38 p refs
(EUR-3288.e)

A numerical solution is given for a cylindrical liner, surrounded by an explosive ring, and bounding a magnetic field. This field exerts a pressure on the internal wall of the liner, while the diffusion of the field on the interior of the liner is neglected. A detonation front, started on the external side of the explosive ring, reaches the liner and pushes it concentrically towards the axis. First the propagation of the detonation front and the state of the gas behind it is computed. Afterwards the interaction liner-gas is treated. The computation is carried out under the hypothesis of axial symmetry.
Author

N67-29978 Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Reaktorzentrum.
THE FUNDAMENTALS OF HEAT EXCHANGER DYNAMICS WITH SPECIAL ATTENTION TO DOUBLE TUBE HEAT EXCHANGERS
H. Eigner 1967 15 p refs
(SGAE-RT-9/1967)

Theoretical work carried out on heat exchanger dynamics is reported. Since, in the majority of relevant publications, the basic principles are not sufficiently brought out, an explanation will be given first of all of the general equations of a convective heat field, together with most of the solutions developed up to the

present time. In this connection, a brief sketch is given of the position we have reached in respect to theoretical work on the dynamics of double tube type heat exchangers in the relevant papers, and a model is treated in detail. In conclusion some points of view are given which should be of use for the broad theoretical handling of heat exchanger dynamics. Author

N67-29987*# Prototech, Inc., Cambridge, Mass.
INVESTIGATION OF CATALYTIC COMBUSTION OF IMPURITIES IN AIR Final Report, 24 Mar.–28 Dec. 1966
Joseph Mesney and Robert L. Novack 30 Jun. 1967 60 p refs
(Contract NAS1-6075)
(NASA-CR-66368; Rept.-111) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A catalytic coil consisting of parallel corrugated ribbons of chromel alternated with layers of asbestos coated with precious metal catalyst, constructed to provide straight-through channels for air passage, was used to oxidize carbon monoxide, hydrogen, and methane, present as dilute impurities in air. Platinum, when applied to the asbestos, was significantly inferior to palladium for the oxidation of methane, the most troublesome of the gases tested. In addition, the catalyst operating temperature was found to decrease with increasing surface concentration of palladium, with length of catalyst, and with decreasing channel size. From this, a plan for an integrated air purification system was developed that would weigh under 25 lbs and remove virtually all the carbon monoxide and hydrogen from the air, leaving a residual of no more than 250 ppm of methane. Author

N67-30085# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
EVALUATION OF BALLISTIC PERFORMANCE OF SOLID PROPELLANTS BY MEANS OF A CONSTANT-VOLUME BOMB
Akira Iwami, Shoichiro Aoyagi, Teruo Sofue, and Kiroku Yamazaki Mar. 1967 14 p refs
(ISAS-410, Vol. 32, No. 3) CFSTI: HC $3.00/MF $0.65

The validity of expressing the covolume of the Noble–Able equation of state as a function of the loading density alone was confirmed from maximum burning pressure data given by Griffin. For nonmetallized propellants, it is possible to use a form of this function induced from semi-empirical thermodynamic calculation. This postulation was applied to several composite solid propellants and on simple procedure yields the specific impulse which approaches theoretical value. Although calculated performances for aluminized propellants show considerable difference from theoretical, these are rather reasonable in view of the data of motor firings. Author

N67-30100# National Aeronautical Lab., Bangalore (India).
STUDIES ON TUBE ARC-HEATERS WITH VARIABLE CROSS-SECTION
T. K. Bose Jan. 1967 24 p refs
(NAL-TN-1)

This report presents a mathematical model of arc-heating in a tube arc-heater with variable radius. Fundamental equations were given, and the numerical solution of differential equations in general and a special case of a one-dimensional flow discussed. The differential equations were solved numerically with the help of high speed electronic digital computer and the results are discussed. Proposals are made for the use of these results for design of a tube arc-heater. Author

N67-30121*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE ATTAINMENT OF CLEAN VACUUM WITH A ONE-WATT REFRIGERATOR
James E. A. John and William F. Hardgrove Washington, NASA, Jul. 1967 12 p refs
(NASA-TN-D-4006) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A 1 watt refrigerator was used to maintain a 2 square foot cryopanel at temperatures below 20°K in a 600-liter vacuum chamber. With the chamber roughed to 50 microns with a mechanical pump, ultimate pressures in the 10^{-8}-torr range were consistently obtained in an unbaked chamber with the cryopanel in operation. To reduce the heat load in the refrigerator, the cryopanel was surrounded with liquid nitrogen cooled chevron baffles. Pumping speeds of the panel for air, argon, and nitrogen of the order of 5000 liters per second were measured over the range 10^{-4} to 10^{-9} torr. The composition of the residual gases in the chamber during several operating conditions is reported. Results of the experimentation indicate that a relatively low capacity refrigerator can be used to produce and maintain high vacuum in a test chamber of reasonable volume. The use of cryogenic pumping serves also to reduce to a minimum the contamination introduced into the test volume by the pumping system. Author

N67-30144*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
NONLINEAR HEAT TRANSFER AND TEMPERATURE DISTRIBUTION THROUGH FINS AND ELECTRIC FILAMENTS OF ARBITRARY GEOMETRY WITH TEMPERATURE-DEPENDENT PROPERTIES AND HEAT GENERATION
A. R. Shouman 14 Jun. 1967 45 p refs
(NASA-TM-X-53821) CSCL 20M

An analytical treatment is presented for the nonlinear differential equation governing the one-dimensional steady-state temperature distribution along a rod or a fin due to the heat exchange between them and the surroundings by both convection and radiation. The analysis includes variation in geometry, dependence of properties on temperature, and internal heat generation. The special case of constant area geometry can be solved exactly including temperature dependent physical properties and with heat generation that at most is temperature dependent only. The solution, however, has to be determined for each case separately depending on the functions describing the dependence of the physical properties and the heat generation on temperature. The solution for the constant area geometry with constant thermal properties leads to the definition of two functions in terms of integrals which can be evaluated numerically to any desired accuracy. For the general case of arbitrary geometry and with physical properties and heat generation that is location dependent as well as temperature dependent, a new method for solving the problem numerically is outlined. Author

N67-30164*# Lockheed-California Co., Burbank.
THERMAL ANALYZER COMPUTER PROGRAM FOR THE SOLUTION OF FLUID STORAGE AND PRESSURIZATION PROBLEMS
A. A. Hiresawa, I. Shuldiner, and Josephine Laue 10 Aug. 1965 300 p refs
(Contract NAS9-3349)
(NASA-CR-65582; LR-18903) CSCL 20M

The computer program described presents an engineering approach toward solution of the problem of tankage system analysis. A mathematical model is described which depicts the thermodynamic behavior of a fluid storage tank system subjected to heating and transient body forces. In the computer representation of this model, the Thermal Analyzer Program serves as the basic building block. A fixed resistance–capacitance network system is assumed, and system fluid properties are treated as functions of time and of axial and radial distance. The tank volume and wall are divided into discrete volumetric elements with the state and properties of the material within each element uniform throughout the element. Stepwise, thermal network relaxation and finite-difference

fluid-mass balance computations using digital computer techniques provide problem solution for tankage system variables as a function of time. Author

N67-30165*# Lockheed-California Co., Burbank.
COMPUTER PROGRAM FOR THE CALCULATION OF INCIDENT ORBITAL RADIANT HEAT FLUX
B. A. Nevelli 18 Jun. 1965 162 p refs
(Contract NAS9-3349)
(NASA-CR-65583; LR-18904) CSCL 20M

A Fortran IV computer program was developed for the computation of orbital variation in incident and reflected solar and planetary emission radiant heat flux on plane surface elements. The program computes the orbit, given the altitude at perigee, eccentricity, inclination, etc., and handles planetary or inertial orientations in either Earth or lunar orbits. The program also handles individual points in space. Non-uniform radiosity of the Earth due to latitude, seasonal variations, etc., is accounted for. By adding appropriate data constants, the program can be extended to include other planets. Computer output is in tabular form. Output options provide punched cards suitable for direct insertion into the Thermal Analyzer program and/or plotted heat input vs. time data. The use of the program is described in detail and is illustrated by several example problems. Author

N67-30166*# Lockheed-California Co., Burbank.
COMPUTER PROGRAM FOR THE CALCULATION OF THREE-DIMENSIONAL CONFIGURATION FACTORS
E. R. Linneman, H. R. Holmes, K. J. Kahn, and B. A. Nevelli 30 Jun. 1965 205 p refs Revised
(Contract NAS9-3349)
(NASA-CR-65584; LR-18905) CSCL 20M

Features of a Fortran IV computer program for the computation of radiation configuration factors, are presented. It is designed to include the effects of interference by intermediate surfaces. It will handle planes, spheres, ellipsoids, elliptic cones, elliptic paraboloids, elliptic cylinders, parabolic cylinders, hyperbolic cylinders, hyperboloids of one or two sheets, hyperbolic paraboloids, and cylinders composed of two parallel or two intersecting planes, in any combination as either surfaces or boundary surfaces. It is also designed to offer a high degree of flexibility in the number of surfaces and boundaries, in the methods of specifying these surfaces in the program input, in the computations performed, and in the trade-off between computing time and accuracy. The use of this program is described in detail and is illustrated by several example problems. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-29004*# International Information, Inc., Philadelphia, Pa.
ECONOMIC ASPECTS OF TECHNICAL AND SCIENTIFIC INFORMATION (REPORT TO THE MINISTER OF THE BUDGET ON THE MEETING HELD BY A WORK GROUP OF THE OCSE) [ASPETTI ECONOMICI DELL'INFORMAZIONE TECNICA E SCIENTIFICA (RAPPORTO AL MINISTRO DEL BILANCIO SULLA RIUNIONE DEL GRUPPO DI LAVORO DELL'OSCE)]
A. Simari Washington, NASA, May 1967 6 p Transl. into ENGLISH from Boll. Inform. Min. Bilancio (Italy), v. 2, no. 85, 24 Feb. 1967 p 13–17
(Contract NASw-1499)
(NASA-TT-F-10891) CFSTI: HC $3.00/MF $0.65 CSCL 14A

The purposes of an OCSE meeting are described and the objectives are outlined. Total cost and cost/efficiency ratio studies are reviewed, and information economy and economic analysis methods are mentioned. A discussion on the internal, comparative analysis of information systems is summarized. N.E.N.

N67-29141*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY 37–44, VOL. IV FOR THE PERIOD FEBRUARY 1, 1967 TO MARCH 31, 1967, SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
30 Apr. 1967 370 p refs
(Contract NAS7-100)
(NASA-CR-84965; JPL-SPS-37-44, Vol. IV) CSCL 22B

Articles summarizing research and development in systems analysis, guidance and control, engineering mechanics, propulsion, space sciences, and telecommunications are presented. For individual titles see N67-29142–N67-29164.

N67-29161*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PHYSICS
In its Space Programs Sum. No. 37–44, Vol. IV 30 Apr. 1967 p 251–269 refs (See N67-29141 16-34)

Reports on investigations in experimental and theoretical physics with applications to space sciences are presented. A spectrometer for simultaneous observation of the spectra of two nuclei of different magnetogyric ratios is described, and NMR spectra of ^{31}P and ^{1}H are examined. Modifications in the gas chromatographic apparatus are indicated, and data from the separations of Ar, O_2, N_2, and CH_4 are used to support the electrostatic theory of physical adsorption. The Gibbs' phenomenon is discussed, and it is shown to be a consequence of the facts that the ordinary eigenfunctions of a linear differential operator form a completer set, and that the torn or discontinuous eigenfunctions have lower eigenvalues than do the ordinary eigenfunctions. Mathematical discussions are presented on the relativistic collapse to a Schwarzschild sphere and on particular solutions of a system of nonlinear first-order ordinary differential equations. N.E.N.

N67-29260*# National Aeronautics and Space Administration, Washington, D. C.
A SELECTED LISTING OF NASA SCIENTIFIC AND TECHNICAL REPORTS FOR 1966
Jan. 1967 2078 p refs
(NASA-SP-7028) Available from GPO CSCL 05B

Abstracts and indexes are presented for selected reports that previously appeared in the 1966 series of Scientific and Technical Aerospace Reports (STAR) published by NASA. Most of the listed documents were issued as part of the NASA special publications; technical reports, notes, memorandums, and translations; and contractors reports. References to journal articles that were published as a result of NASA-sponsored or NASA-supported activities are not included. Arrangement of the publication is the same as that of STAR, with the first section containing bibliographic citations and abstracts arranged according to 34 subject categories. The second section contains five indexes: (1) subject, (2) corporate source, (3) personal author, (4) report/accession number, and (5) accession/report number. M.W.R.

N67-29424# RAND Corp., Santa Monica, Calif.
REQUIREMENTS FOR COLD-WEATHER RESEARCH
J. O. Fletcher Mar. 1967 11 p refs Presented at the 57th Air Force Ind. Conf., Riverside, Calif., 8 Mar. 1967
(P-3549; AD-649781) CFSTI: HC $3.00/MF $0.65

Since World War II the Air Force's generation of requirements for cold-weather research and development has been very effective in removing cold-weather limitations on equipment and on normal methods of operation. However, the Air Force has largely failed to generate requirements for new methods of operation that would exploit unique environmental factors in cold regions. Author (TAB)

N67-29439# Congress. House. Committee on Science and Astronautics.
NASA AUTHORIZATION FOR FISCAL YEAR 1968, PART 2
Washington, GPO, 1967 1425 p Hearings before Comm. on Sci. and Astronautics, 90th Congr., 1st Sess. on H.R. 4450, H.R. 6470 (Superseded by H.R. 10340), 14–16 and 20–21 Mar. 1967
GPO: $4.00

Extensive data are presented in support of NASA's budget request for the continuation of the Apollo program. Attention is focused on how the Gemini flights contributed to the Apollo, Apollo Applications, and potential future space flight missions, and on how the technical and information utilization phase of the program will continue in follow-on programs. Summarized data are included on the transcripts of the hearings held at various contractor locations and NASA Centers. Details are also given on construction of facilities and administrative operations. M.G.J.

N67-29498# Yale Univ., New Haven, Conn. Cowles Foundation for Research in Economics.
THE ROLE OF THE NEYMAN–PEARSON LEMMA IN THE THEORY OF DISCRETE SEARCH
Joseph B. Kadane 3 Mar. 1967 20 p refs *Its* Discussion Paper No. 220
(Contract Nonr-3055(00))
(AD-649850) CFSTI: HC $3.00/MF $0.65

Suppose an object is hidden in one of n boxes, it is in box k with probability p sub k, k = 1, ..., n. If it is in the k th box, a search of the k th box may overlook it with probability alpha sub k, 0 < alpha sub k < 1. The events E sub (j,k) that the object is found in the j th search of the k th box are disjoint, and P sub jk = Pr(E sub j,k) = p sub k alpha sub k to the (J-1) power (1-alpha sub k) for k = 1, ..., n and all positive integers j. Suppose also that each search of box k costs c sub k > 0. The main problem considered in this paper is how to search in order to maximize the probability of finding the object spending no more than a fixed amount C. Author (TAB)

N67-29499# Yale Univ., New Haven, Conn. Cowles Foundation for Research in Economics.
MATHEMATICAL STRUCTURE AND ANALYSIS OF THE NONSYMMETRIC GAME, PART IV
Richard Levitan (IBM, Yorktown Heights, N. Y.) and Martin Shubik 2 Mar. 1967 42 p refs *Its* Discussion Paper no. 219
(Contract Nonr-3055(00))
(AD-649849) CFSTI: HC $3.00/MF $0.65

The prime concern of the paper was the formulation and exploration of an explicit mathematical model of a nonsymmetric oligopolistic market. There are many different concepts of 'solution' which may be applied to such a structure. It is believed that (at least based upon experience with oligopoly games) the noncooperative equilibrium solution is the best short term predictor of behavior. It was observed that by making both behavioral (noncooperative equilibrium) and structural (the quadratic payoff functions) assumptions, parameters could be estimated from corporate and other market information. A game was produced with parameters that look 'somewhat like' an actual industry and has the property that the noncooperative solution gives the profits, sales and prices of that industry at a point in time. The assumptions of a linear aggregate demand function and of constant average costs with capacity limitations lead, in the symmetric case, to quadratic payoff functions for the firms and in the nonsymmetric case to the model formulated. Given the difficulties in microeconomic measurement and the complexity of even high simplified N-firm market models the detailed exploration of solutions of models with more complex demand or cost functions does not appear to be merited at this time. It is not evident that any qualitatively different phenomena will be encountered by using quadratic or higher approximations for demand or cost conditions. Author (TAB)

N67-29573# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
William M. Leak, ed. Feb. 1967 54 p refs
(PB-174051) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. AIRBORNE INSTRUMENTS FOR TRACER STUDIES IN CLOUDS E. C. Jones, C. M. Gordon, R. E. Leighton, and J. I. Hoover p 1–7 refs (See N67-29574 16-14)
2. FREQUENCY CONTROL OF NAVY VLF STATIONS R. R. Stone, Jr. p 8–16 refs (See N67-29575 16-07)

N67-29577# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
William M. Leak, ed. Jan. 1967 65 p refs
(PB-173834) CFSTI: HC $3.00/MF $0.65

CONTENTS:

1. RAPID BIOLOGICAL DETECTION OF SLIGHT VARIATIONS IN A METAL SURFACE P. J. Hannan and C. Patouillet p 1–7 refs (See N67-29578 16-04)
2. MILLIMETER-WAVE RADIO ASTRONOMY AT NRL R. W. Hobbs p 8–15 refs (See N67-29579 16-30)

N67-29650# Transportation Consultants, Inc., Washington, D. C.
AIDS AVAILABLE FOR COMPATIBLE LAND USE PLANNING AROUND AIRPORTS
Jun. 1966 101 p refs
(Contract FA-65-WA-1357)
(AD-650271) CFSTI: HC $3.00/MF $0.65

Each and every airport, and its environs, is different from every other airport, and must be considered individually in solving its problems of incompatible land uses, or in providing for compatible land uses in the airport area. The government and other aids set forth in this report as means of regulating land uses around airports will provide the greatest benefit to the community as a whole when they are used in conjunction with comprehensive planning for the development of the community. The present Model State Airport Zoning Enabling Act considers only airport hazard areas and does not provide for consideration of incompatible land use areas or aircraft noise and other aircraft-induced operational problems. There is a need for the development of model housing and building codes that specify noise construction standards for buildings in airport environs. Such codes could be made part of zoning regulations around airports. TAB

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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